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HON. LOUIS CODERRE, MINISTER; R. W.

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BY

D. B. Dowlin

OTTAWA
GOVERNMENT PRINTING
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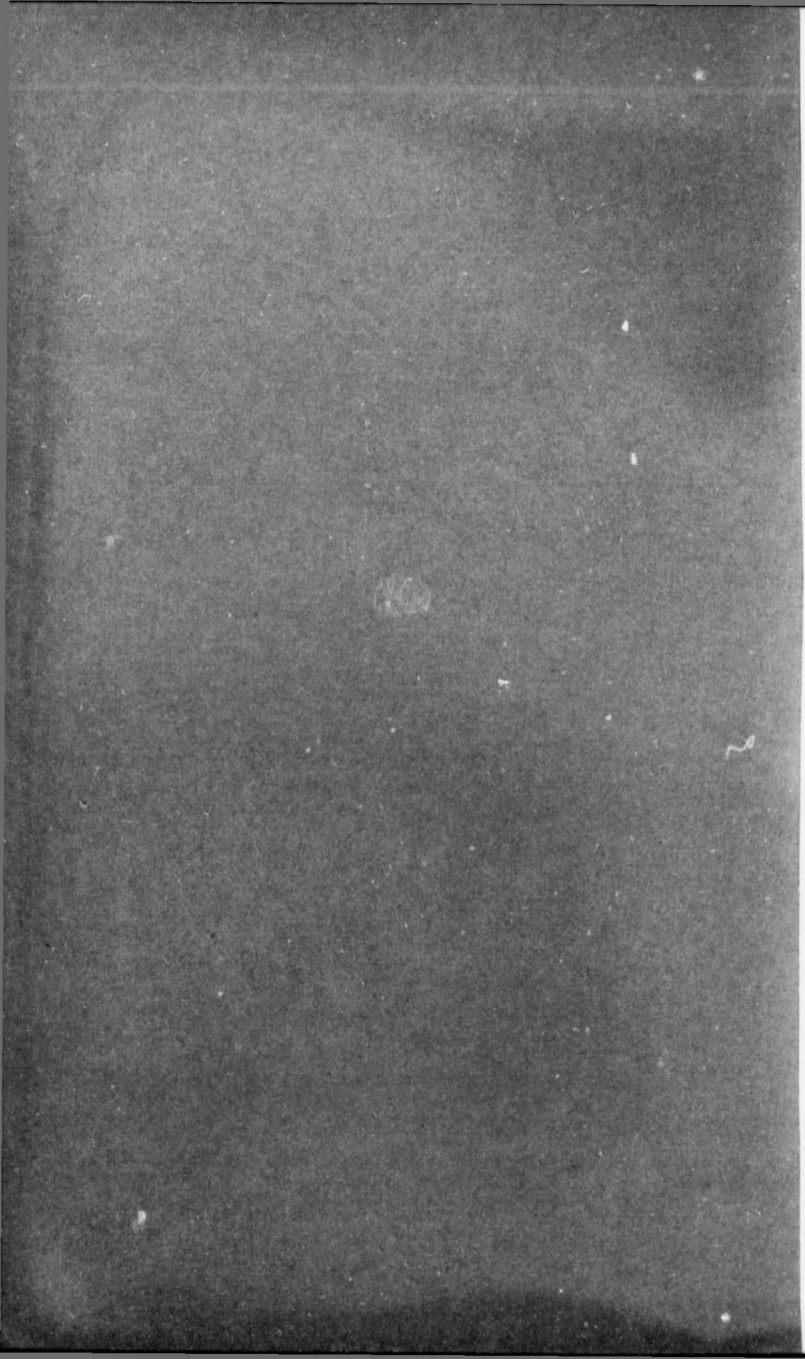

Coal Creek, Fernie, B.C., 1898.

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The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia

INTRODUCTION.

This report is intended as a concise statement of the area and probable contents of the various coal fields of the middle portion of Canada. In its preparation, many published reports giving details of the thickness of seams and character of the enclosing rocks have been consulted, and references to these added so that they may be further studied. No attempt is made to treat the subject in detail, except as regards the character of the coal.

The coal analyses already published are scattered throughout many reports, and an effort has been made here at a compilation of this material, in the form of tables of analyses, while for the purpose of comparison, other analyses of North American and foreign coals have been added.

LOCATION AND AREA OF COAL FIELDS.

In Manitoba, the coal-bearing rocks occupy a small area in the southern part, underlying an elevated portion called Turtle mountain. Thin seams outcrop around the base of this hill, and it is probable that others may be found higher up its slopes. With our present knowledge we can define an area of about 48 square miles near the western end of this hill as being available for mining.

The Saskatchewan areas lie principally in the southern part, and are being mined on the Souris river. The elevation known as the Coteau is also composed of coal-bearing rocks which continue westward in the Wood mountains and Cypress hills. This area, although not well prospected, contains possibly 4,000 square miles within which coal may be found. Between the two

branches of the Saskatchewan river there is an area of possible coal-bearing rocks; but the horizons having good workable seams farther west, appear in this area to be rather poorly supplied, so that the value of this part as a coal field is problematical.

The Province of Alberta, as will be seen from the accompanying map, is liberally supplied with coal areas. The western border of the southern part of the Province consists of several ranges of mountains, formed generally of rocks which were, originally, the floor on which the coal formations were laid down. The elevation of the coal formations subjected them to greater denudation than the harder rocks beneath, consequently little of this material is left; but in the wider valleys remnants are still found. These, from the superior quality and amount of coal, form very valuable coal fields. The foothill belt, although not well prospected, will be found to contain many valuable areas in which a softer grade of coal may be found.

East of the foothill area, lies a great extent of coal-bearing rocks which are comparatively undisturbed. The coal in this region is well suited for domestic use; and as it is within the settlement belt, where wood is scarce, a demand for it is assured. These areas are delineated on the map as being occupied by the Edmonton formation and the coals may be referred to as the Edmonton coals. They extend north from near the International Boundary to near the Peace river, underlying an area of at least 52,000 square miles of which 24,000 are considered as available for mining.

Another coal formation, the Belly River formation, occupies the southeastern border of the Province, with an area of 11,568 square miles; the seams in this are of more value in the southern portion than farther north or east. The principal mines of this area are to be found near Lethbridge.

The eastern British Columbia areas are discussed principally because their structure is intimately related to that of the Alberta areas within the mountains. The valley of Elk river, which heads near the source of the Kananaskis, and occupies the same valley as the upper part of the latter stream, has exposures of coal-bearing rocks of the same horizon as those being mined in Alberta, at Canmore, Bankhead, Blairmore, and Coleman.

HISTORICAL SUMMARY.

Many of the published accounts of pioneer journeys contain references to the presence of coal seams. This was to be expected from the fact that, many of the exposures on the stream banks were plainly in view, and some of them were probably on fire.

The earliest mention of coal in the central part of the continent was, probably, that by Sir Alexander Mackenzie in 1789, of a coal seam on Great Bear river in the north. In the eastern part of Canada, under the French occupation, coal was mined before this time, near the mouth of Salmon river in New Brunswick.

The earliest intimation of the occurrence of coal in the area under discussion is probably that which is to be found on a map furnished by Arrowsmith, for Mackenzie's voyages through North America, published in 1801; and a later edition by Arrowsmith published in 1811, on which is shown Peter Fidlers route across the plains, in 1793. These both show that coal had been observed on the Red Deer river, somewhere near the mouth of the Rosebud.

David Thompson, one of the early pioneers, in 1800 made a trip from Rocky Mountain House down the Saskatchewan, and noted the coal seams; but his journal is still unpublished.[1] Alexander Henry, trading for the North West Company, records coal at Rocky Mountain House, and mentions seeing in 1811, during his journey down the river, the thick seam near Goose encampment: which he estimates at about 30 feet in thickness.[2]

The coal at Edmonton was noted by Sir George Simpson, in 1841;[3] and ten years later, Sir John Richardson obtained specimens, and considered them to be of the same horizon as the coal on the Mackenzie river.[4]

Father De Smet crossed the mountains from the westward in 1845, passing Rocky Mountain House. In the foothills, or in the vicinity of the mountains, coal was seen on some of the streams—probably branches of the Red Deer river.[5]

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[1] Annual Report Geol. Surv., Can., Vol. II., p. 8 E.

[2] New Light on the Early History of the Greater North West, by Elliott Coues, Vol. 88, pp. 702 and 741.

[3] Narrative of a Journey Round the World, 1841-2, by Sir George Simpson, Vol. I, p. 101.

[4] Journal of a Boat Voyage through Ruperts Land, p. 195.

[5] Oregon Missions, by Father P. J. De Smet, New York, 1847, pp. 150-160.

In 1857, Sir James Hector found coal on Souris river near the present mines. In 1858, he described the coal at Edmonton and also that on the Red Deer river south of Edmonton: remarking that the coal at Edmonton was in use in the forges, and had proved satisfactory. In 1860, he saw the coal seams on the Athabaska and on the Pembina near where the Grand Trunk Pacific railway crosses that stream.[1]

In 1863, Lord Milton and Dr. Cheadle recorded the use of coal in the forges at Edmonton, from the seams in the river bank, and also mention seeing thick coal seams on the Pembina.[2]

Dr. Grant in "Ocean to Ocean"—the record of Sir Sandford Fleming's trip across the continent in 1872—also refers to the Edmonton and Pembina coals, and to the reported occurrence of vast beds of coal on the Brazeau.

In 1873, Dr. A. R. C. Selwyn descended the Saskatchewan, and recorded in much greater detail the coal seams on this river. This is the first report by an officer of the Canadian Government. It is accompanied by a report on the coal of the Dirt hills in Saskatchewan, by Dr. R. Bell.[3]

Discoveries of coal near the International Boundary were made during the progress of the survey of this line. Attached to the commission as naturalist, was Dr. G. M. Dawson, who reported very fully on the geology of the country, and paid special attention to the evidences of coal underlying the plains. The coal at Roche Percee, discovered in 1857, was fully reported upon, and analyses made. In the vicinity of Milk river, small coal seams were noted for the first time.[4]

Coal was probably mined at Coal Banks, Belly river, before the advent of the Mounted Police in 1874. It was then teamed to the barracks at Macleod.

The coal seams at Blackfoot crossing were recorded by Prof. John Macoun in the report of the Canadian Pacific Railway survey for 1879.

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[1] Papers relative to the Exploration by Capt. Palliser, London, 1859, pp. 22, 25, 44.
Further Papers relative to the Exploration by Capt. Palliser, London, 1860, p. 25.

[2] The North West Passage by Land, by Milton and Cheadle, London, 1865, p. 201.

[3] Report of Progress, Geol. Surv. Can., 1873–74, pp. 16–87.

[4] British North American Boundary Commission. Report on the Geology and Resources of the Region in the Vicinity of the Forty-Ninth Parallel, by G. M. Dawson, Montreal, 1875.

The geological structure of the area was roughly outlined by Sir James Hector, but to Dr. G. M. Dawson, R. G. McConnell, and J. B. Tyrrell fell the lot of making the detailed examinations which gave us a true insight into the structure and areal distribution of the measures. Most of the coal is found in three distinct horizons in the Cretaceous, separated by shales of marine origin. Occasional seams are found in the Tertiary in Alberta, and several important ones are being mined in the lower Tertiary of Saskatchewan and Manitoba. The lowest coal formation, the Kootenay, is at the base of the Cretaceous as indicated by its fossil flora, though it lies just above the Fernie shale now understood to be of Jurassic age. The line of demarcation between these two formations is not very sharp, as the shales of the Fernie, in their upper part, become interstratified with sands and gradually pass into the Kootenay sandstones with their contained coal seams. The Dakota, above this, does not appear to be coal-bearing in an economic sense, and not until the top of the Belly River formation is nearly reached does there appear to have been land conditions of sufficiently long duration for the growth of material to form coal beds. The coal horizon in the Belly River contains only a few workable seams, but its areal distribution makes it important. The third coal horizon is at the top of the Cretaceous, and includes part of the old Laramie formation. It bears many lignite seams, and in Alberta is given the name, Edmonton formation, the highest member of the Cretaceous.

The coal horizons are as below:—

(1) Lower Tertiary.

Paskapoo in Alberta; Fort Union in Saskatchewan.

(2) Cretaceous.

(*a*) Edmonton in Alberta; Lance beds in Saskatchewan.

(*b*) Belly River formation.

(*c*) Kootenay formation.

EARLIER MINING.

Previous to the advent of the railway there seems to have been very little attempt at mining, although it is believed that about the year 1880, about 25 tons were shipped from Roche

Percee down the Souris to Winnipeg, by a barge built at the mine from lumber whipsawed in the vicinity.

Subsequent developments in coal mining followed railway extension very closely. In 1888, coal was discovered near Banff, on the Cascade river, opposite the present Bankhead mines. Mining here, however, was discontinued as soon as the seams were discovered near the railway at what was afterwards called Anthracite. This mine was leased in 1891 to H. W. McNeil & Co., who continued mining until 1904.

The coal mines at Lethbridge were preceded by primitive attempts at mining from the banks of the river. After a company was formed and plant erected, the industry began to assume importance, and shipment may be considered to have commenced about the year 1886.

The well established mining industry at Canmore commenced about 1888, at what is known as the Cochrane mine, a mile up the river from the present slope. In 1891 the Canadian Pacific railway built a spur down the river to the mouth of the gully opposite White Man pass, where the present mining plant is installed. An extension south to the Sedlock prospect was finished in 1907, thus opening another new mine.

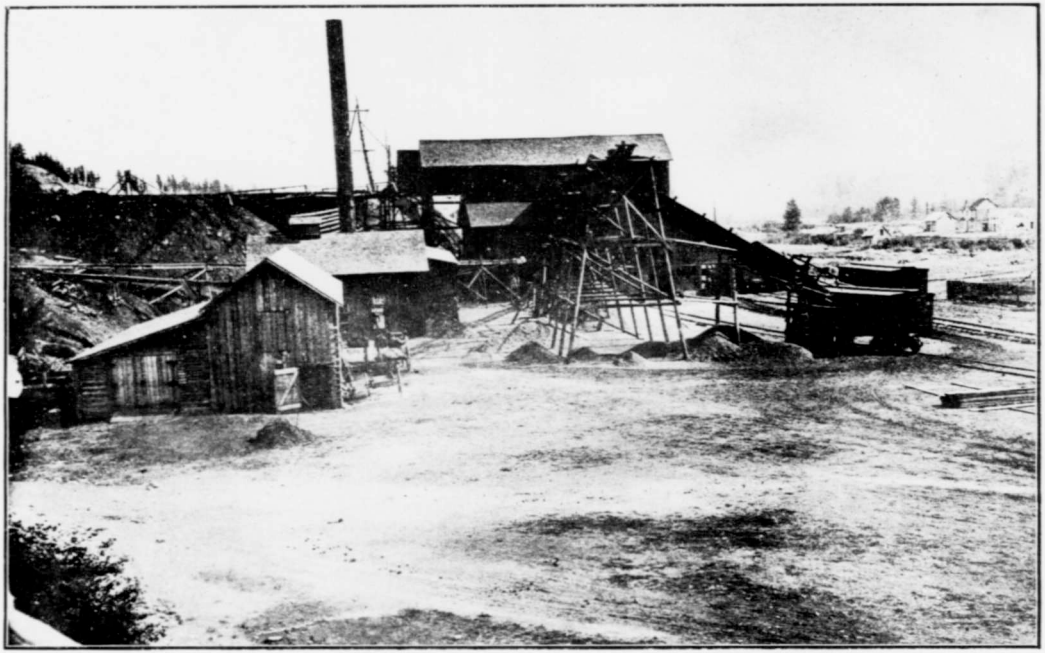
A mine near Cochrane was opened in 1885, known as the Bow River mine. This was closed in 1888 and another opening made nearby for a new company; but for many years this has been closed.

Near Medicine Hat, the coal seams on the Saskatchewan have been mined since 1883. The most prominent are in the neighbourhood of Stair.

The Crowfoot seams were worked in a desultory manner by the Blackfoot Indians, and for a time the Canadian Pacific railway made attempts at mining on Crowfoot creek, north of the railway, commencing operations in 1888.

The progressive development of the Edmonton mines closely followed the growth of the settlement. With the advent of the railway they rapidly increased in importance, and by consolidation, and increase of capital, their operations were placed on a more permanent basis.

Kneehills mines were opened in 1893, but as they are far from a railway, they have—by the primitive means used—taken out only enough coal to supply the immediate settlers.



Coal mine at Anthracite, 1898.

Lethbridge. First opening in river bank, 1881.

The greatest amount of mining has been along the line of the Crowsnest branch of the Canadian Pacific railway, in the mountains. This followed immediately on the completion of the railway, and practically within recent years.

In Manitoba, there was promise at one time of a mine at the west end of Turtle mountain, south of Goodlands. About 1890, several holes were bored, and a shaft put down; but for some reason the industry was discouraged. South of Deloraine, coal has been taken from a couple of thin seams for several years, but there has been no continuous mining.

ESTIMATES OF AREA AND COAL CONTENT.

The problem of forming an estimate of the coal content is exceedingly difficult, and the aim in this review is to give what might be called the maximum value from the knowledge we at present possess. The minimum will be arrived at only after years of prospecting, and will, we hope, be well up to the present estimate.

In the small, rich areas in the mountains, the measures are best exposed, so that from the sea better estimate of coal content can be made—a much closer one than in the case of flat-lying measures, having exposures of coal seams at great distances apart, with few drill holes to prove the intervening portions. On the plains, so little is the evidence of disturbance of the beds that a large area in the vicinity of a heavy seam may reasonably be classed as workable. If, however, the area depends for coal on one seam alone, there is a constant danger that it may taper off in thickness, or split up into unworkable seams by an increase in the partings.

A low estimate of the general content is, therefore, to be placed on the areas outside the mountains, and even this in the end may prove excessive.

For limited areas where heavy seams are known—as in the country south and west of Edmonton—the estimate is probably low enough, but in the less explored areas the estimate may be too high.

The Saskatchewan areas of the southern part may produce sufficient coal to warrant the estimate put on them; but the amount of coal in the portion northeast of Medicine Hat is problematical, since few seams have as yet been found.

The estimate published in the first edition of this memoir was intended to apply to easily mined coal in fairly large seams. The amounts now given are estimated on the basis of all coal in seams of over one foot and at depths to 4,000 feet from the surface, and are, therefore, much larger than those of the first estimate.

KOOTENAY FORMATION.

Eastern British Columbia.

Exposures of the Kootenay measures are to be found in the Elk River valley, which heads near the Kananaskis. The field, which has been generally known as the Crowsnest area, contains 230 square miles of coal lands; estimated to contain 22,586,342,000 tons of bituminous coal as well as a possible large reserve deeply buried and probably difficult to recover. North of this, on the upper waters of Elk river, an additional area of 134 square miles has an estimated reserve of 12,941,000,000 tons. South, on the Flathead river, a small area is thought to contain 600,000,000 tons.

Alberta.

The Kootenay coals in Alberta are generally exposed in narrow bands in the mountains. These are here enumerated in order from south to north.

Coleman Area. The Coleman area is estimated at 35 square miles with 38 feet of coal, giving an estimated reserve of 1,050,000,000 tons.

Blairmore-Frank Area. The Blairmore-Frank area is irregular in shape and broken by faults and folds; but assuming for it an area of 90 square miles, with an estimated thickness of 50 feet of coal, its total content would be 4,500,000,000 tons.

Livingstone Area. The Livingstone area lies north of Blairmore and west of the Livingstone range of mountains. The area containing coal approximates 343 square miles. A maximum estimate of its coal reserve would be 26,000,000,000 tons.

Moose Mountain Area. The Moose Mountain area, lying outside the first range of the Rocky mountains, consists of a narrow band encircling the upthrust Palæozoic rocks forming the mountain. It extends from near the main line of the Canadian Pacific railway, south to Sheep river. Its area is estimated at 12 square miles, with a thickness of 15 feet of coal. This would give a probable coal content for the area of 200,000,000 tons.

Cascade Area. The Cascade area is a long strip between the ranges, containing workable seams for a length of about 40

miles. It is estimated to contain about 769,000,000 tons of anthracitic coal, and of the softer grades, 2,099,000,000 tons.

Palliser Area. The Palliser area, on Panther river, is comparatively small, but with an area of perhaps 6 square miles, has, possibly, a coal content of 30,000,000 tons.

Costigan Area. The Costigan area lies east of Palliser and in its area of 12 square miles is estimated to contain possibly 90,000,000 tons, mostly bituminous coal.

Bighorn Area. The Bighorn area, between the Saskatchewan and Brazeau rivers, is estimated at 87 square miles, with a reserve of at least 6,000,000,000 tons.

Nikanassin Area. The Nikanassin area, the continuation northward of the Bighorn area, is estimated to contain in 48 square miles, 1,404,000,000 tons of which 259,000,000 is easily accessible.

Shunda Creek Area. This area lies east of the Bighorn area and with its continuation south and north, in an area of 25 square miles over 2,000,000,000 tons are predicted, of which 160,000,000 tons lie in an already prospected block.

Folding Mountain and Brule Lake Areas. The Folding Mountain and Brule Lake areas lie outside the mountains, on each side of the Athabaska river, and for these, an area of 10 square miles is estimated to contain 361,000,000 tons.

Roche Miette and Moose Creek Areas. Roche Miette and Moose Creek areas lie inside the first range at the Athabaska, and for an area of 38 square miles are estimated to contain 624,600,000 tons.

Other areas north of the Athabaska are known to contain coal; but the delineation of these areas has not yet been undertaken.

BELLY RIVER FORMATION.

Alberta and Saskatchewan.

The coals that belong to the Belly River horizon, grade gradually between lignite and bituminous, and are found over an enormous area. Roughly measured on the map, this area is about 33,192 square miles. An estimate on this basis would, however, be very misleading, since portions are known to be either unproductive, or to contain only small seams of inferior

coal. Possibly the best areas are outside the boundaries of the exposures of the formation, since the upper coal seam may be considered as the base of the Pierre or Bearpaw shales. A total coal reserve, including these extensions, has been estimated at 223,358,000,000 tons, but a large part of this may not be immediately available. Most of the productive value is in Alberta. The proportions for the two provinces may be assumed as 189,450,000,000 tons for Alberta, and 33,908,000,000 tons for Saskatchewan.

EDMONTON FORMATION.

Alberta.

The coals of the Edmonton formation are generally lignites, but in the foothills grade up to bituminous. The foothill areas, though only narrow bands, have a length of about 400 miles. In the less disturbed areas at a distance from the mountains, this formation occupies an enormous trough, in the centre of which sandstone of Tertiary age probably forms a heavy cover and beneath which it may be impracticable to mine the coal. Surrounding this deeply concealed part, it is estimated that there may be an area of 52,405 square miles underlain by coal with an estimated maximum reserve of 800,958,000,000 tons. Half of this area is considered to have a more certain reserve which is placed at 383,697,000,000 tons of sub-bituminous coal.

TERTIARY FORMATION.

Saskatchewan.

The coals of the Tertiary are all lignites. The Souris area, of eight townships, is estimated to contain 2,304,000,000 tons; while the remaining portion lying to the west—consisting of 5,900 square miles—has possibilities up to about 23,600,000,000 tons; a total for the area of 25,904,000,000 tons.

Manitoba.

The Turtle Mountain area in the southern portion of the Province, has an available area of 48 square miles, probably coal-bearing, which with 4 feet of coal, represents a possible total of 160,000,000 tons.

SUMMARY STATEMENT OF ESTIMATES.

	Square miles	Million tons.	
Eastern British Columbia	370	56,878,	Bituminous.
Alberta:—			
Coleman area	35	1,050	"
Blairmore-Frank	90	4,500	"
Livingstone	343	26,000	"
Moose mountain	12	200	"
Cascade	56	2,099	"
Cascade		769,	Anthracite and semi-anthracites.
Palliser	6	30,	Bituminous.
Costigan	12	90	"
Bighorn	87	6,000	"
Nikanassin	48	1,404	"
Shunda	25	2,160	"
Folding mountain and Brule lake	10	361	"
Roche Miette and Moose creek	38	624	"
Northern areas	13	159	"
Belly River area	25,974	189,450,	Sub-bituminous and lignite.
Edmonton formation	52,405	800,958	"
Tertiary beds	2,520	23,721	"
	81,674	1,059,975	
Saskatchewan:—			
Tertiary beds	6,188	25,904,	Lignite.
Belly River beds	7,218	33,908	"
	13,406	59,812	
Manitoba:—			
Turtle mountain	48	160,	Lignite.

The total estimate for the three provinces of Manitoba, Saskatchewan and Alberta, and for the eastern part of British Columbia, approximates 95,598 square miles of coal lands with 1,176,825,000,000 tons of coal in reserve. In this total the various classes of coal occur in the following proportions:—

Anthracite and semi-anthracite	769,000,000 tons.
Bituminous	242,313,000,000 "
Sub-bituminous	847,321,000,000 "
Lignite	86,422,000,000 "
	1,176,825,000,000 "

COAL PRODUCTION.

Eastern British Columbia. The mines of the Crowsnest district began shipping in 1899. The demand for a steam and coking coal for the mining districts of the western states and British Columbia, caused a rapid increase in the output in a few years. Coal for railway use has been extensively drawn from this field. A summary of the amount mined for thirteen years is subjoined.

Year	COAL					COKE		
	Total output of mines	Domestic sales	Sold for export	Made into coke	Consumed at collieries	Coke made	Domestic consumption	Exported
1900	206,803	92,926	7,968	103,031	2,678	65,915	27,065	38,958
1901	369,355	121,645	72,862	180,768	4,080	111,683	77,241	32,121
1902	393,961	111,711	101,776	170,460	10,023	107,837	81,073	26,764
1903	589,888	153,573	145,010	249,551	20,376	149,764	122,006	27,757
1904	662,685	168,980	118,188	350,900	24,617	218,857	119,004	97,690
1905	831,933	148,939	246,002	397,828	35,843	256,125	145,044	113,337
1906	720,449	150,793	230,863	304,045	34,748	189,385	134,646	53,400
1907	876,731	218,221	291,410	322,870	44,230	206,541	140,987	59,890
1908	883,205	200,908	266,829	360,250	60,117	234,868	206,413	34,196
1909	923,865	136,406	353,389	365,464	68,170	245,017	205,391	40,478
1910	1,365,119	182,578	751,087	334,519	93,376	215,696	204,947	8,730
1911	442,057	95,139	209,894	104,656	35,627	66,005	66,034	1,267
1912	1,261,212	231,076	551,742	396,905	79,344	264,333	213,041	50,257

Alberta and Saskatchewan. The output of the mines of these two provinces, taken from census reports and the provincial returns, shows a great increase in the period between 1901 and 1910.

	Production of Coal in Tons				
	1881.	1891.	1901.	1906.	1910.
Alberta	1,590	174,131	280,000	1,385,000	3,036,757
Saskatchewan			40,909	170,582	175,034
	1,590	174,131	320,909	1,555,582	3,211,791

This rapid rise in the rate of production suggests that it must be due not only to increase in population, but also to the extension of railways and the introduction of manufacturing industries. This is borne out by the population returns covering approximately the same period.

	Population.				
	1881.	1891.	1901.	1906.	1911.
Alberta.....	18,075	26,277	68,376	185,412	374,663
Saskatchewan....	19,679	40,522	90,564	257,763	492,432
	37,754	66,799	158,940	443,175	867,095

The above table shows that the coal consumption is increasing at a much more rapid rate than the population. In considering, therefore, the future needs of the northwest provinces, it is quite evident that in a few years—unless new mines are opened—the present plants will be taxed to their full capacity.

The first need of the population is domestic fuel, and much of this is being supplied from the lignite belt. Transportation and manufacture next demand fuel for power production. Thus the per capita coal consumption will increase with added population.

The coal available in Alberta is of all grades, from lignite to anthracite, and mines producing each kind have been opened up. In Saskatchewan the lower grades only have been found.

COAL MARKETS.

The metallurgical market in Canada is at present British Columbia; the foreign, which may be supplied from this coal area, is in the United States, immediately to the south. The areas crossed by the Crowsnest branch of the Canadian Pacific railway supply coking coal, and several of the collieries are making coke. On the main line of the Canadian Pacific railway, no coking coal is being mined. Farther north, the new transcontinental roads will build branches to reach possibly the coking coals of the areas near the Saskatchewan river in order to supply the market that will be created by the opening of northern British Columbia.

For railway power the supply will have to come from the vicinity of the mountains, and this can only be obtained—for amounts above the present available tonnage—by a larger output from the mines on the railways crossing the mountain coal areas; or by running branches to other available areas. The Ohio coals can be shipped via the lake route, and compete with the western coals as far as the western border of Manitoba.

For domestic and manufacturing purposes the coals of the plains will maintain their market against the higher grade coals of the foothills and mountains, because of the shorter haulage to market, and their relative cheapness. For power stations, the lignites have been demonstrated to be admirably adapted for gas producers; and as they are to be found very near the area which is expected soon to have a large population, the market for this class of fuel is assured. The extension of railways, through the fertile, treeless areas cannot of itself cause permanent settlement; reasonably cheap fuel is also necessary. The western portion of Saskatchewan is being crossed by railways, several of which cross the treeless area; but as they are being constructed mainly from the east, permanent settlement will follow only when these branches cross the Alberta coal areas, and render the coals available for a fuel supply. Coal mining in the vicinity of Edmonton is just now changing. Hitherto, the demand has been

purely local; but now—owing to the advent of railways—shipments are being made to distant parts, which has necessitated better equipment, and the installation of additional machinery in the existing plants.

In Saskatchewan, the southern coal area is crossed by the "Soo" branch of the Canadian Pacific railway, and one from Estevan eastward to Manitoba. The facility with which this lignite can be marketed, both north and east, together with the increase in population, has raised the production of the mines on the Souris from about 40,000 tons in 1901, to over 100,000 in 1906.

Activity in mining for the domestic market is generally greatest during the autumn and winter months; but this period also constitutes the busy season for the railways, hence there is often difficulty in securing the necessary cars. If it could be arranged that coal could be stored under cover during the summer months, coal famines would not occur.

GENERAL CHARACTER OF THE REGION.

TOPOGRAPHY.

The topography of the district included within the provinces discussed, consists of many diverse types, due both to structure and erosion. The most prominent feature is the Rocky mountains. This series of ranges, as will be seen from maps of such areas as the Crowsnest or Cascade coal fields, is merely a series of inclined blocks of the harder rocks of Palæozoic age capped by softer Cretaceous beds. They present a rugged outline and steep faces from weathering and glacial erosion; but their topographic features do not indicate great age, as is shown by the close connexion between their structure and present form. The three provinces to the east of the mountains, although generally called plains, are in reality undulating table lands, which may be divided roughly into four topographic divisions. The first consists of a plain lying upon the Pre-Cambrian floor, from which all but the Palæozoic rocks have been removed; and in Manitoba this is smoothed over by deposits of glacial drifts and by the sediments laid by the glacial lake Agassiz. The second is a plateau which has for its eastern edge the northeastern escarpment of the Cretaceous shaly deposits. The third division is more diverse in character; but is roughly outlined on its eastern edge by the declivity known as the Coteau. The rocks which are exposed throughout this division have a larger proportion of sandstones among them than in the second. To this, no doubt, is due the greater relief in the topography. The fourth division may be called the foothills area, and the character of its topography is due more to structure than to denudation. The foothills consist generally of ridges of inclined strata running parallel to the Rocky mountains, cut through at intervals by stream valleys.

First Division. This is the lowest in elevation and is essentially a region of lakes, with the exception of the southern end which is covered by silts and clays of lacustrine deposition

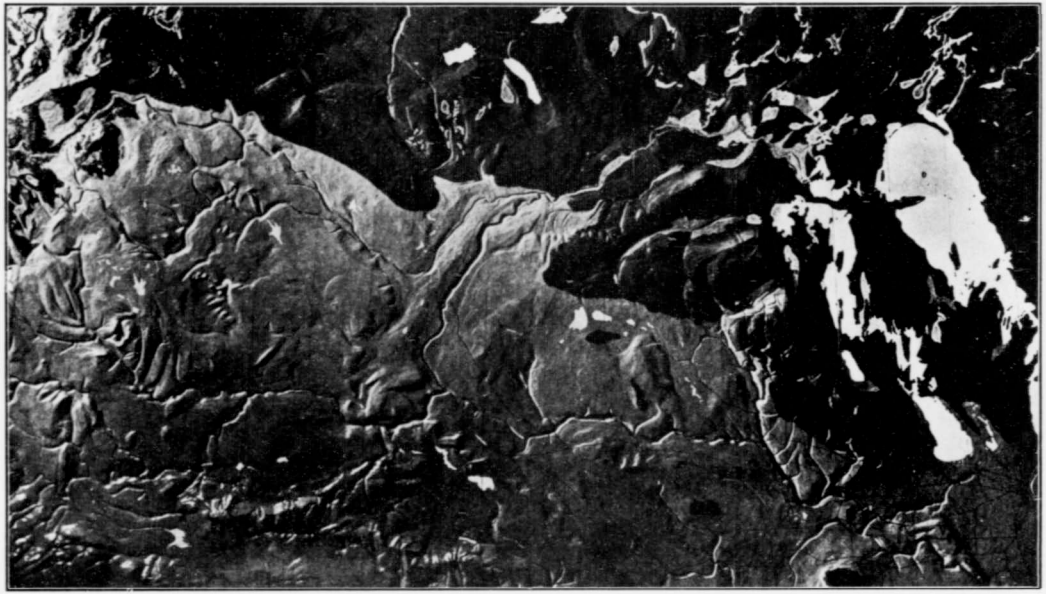
now forming the fine farming lands of southern Manitoba. The drainage is northward to the Nelson river, which flows to Hudson bay. The surface features east and north of Lake Winnipeg differ from those to the west in that this eastern part is mostly of the mammillated character usually found in a country underlain by Pre-Cambrian rocks, with only a thin mantle of surface drift.

Second Division. The second topographic division consists of a plateau formed of shales and other soft rocks. The surface has suffered great denudation, so that its general elevation is hard to estimate; but a large portion of the area is nearly 1,000 feet above the level of the Manitoba lakes. Several valleys have been eroded through the escarpment. The wider openings are those through which flow the Assiniboine and Saskatchewan rivers, whose valleys, back from the face of the escarpment, show as deep narrow cuts with frequent scarped banks. The eastern edge of this plateau between the indentations formed by drainage channels, forms the elevations known as the Pembina, Riding, Duck, Porcupine, and Pas mountains.

In this division the drainage is divided between the general eastern drainage of the Qu'Appelle, Assiniboine, and Souris waters, and the northeastern drainage of the Saskatchewan.

Third Division. This, extending from the Coteau to the foothills, may be considered as consisting of three sloping planes from which its recent topography has been derived. The dividing lines between these three planes are: the watershed between the two branches of the Saskatchewan, and the valley of the Belly river. North of the watershed mentioned, the country slopes generally from the mountains northeasterly, and is drained radially by streams that run to Hudson bay and the Mackenzie valley. South from this the slope is southeastward to the depression occupied by the Belly river. Southward again the slope changes to nearly east; but following the valley of the South Saskatchewan we find north of the Cypress hills and Wood mountains, a slope to the north.

On these plains the relief is very much accentuated by the fact that much of the country is bare of timber; but elevations such as the Cypress hills, standing 2,500 feet above the level of the railway at Irvine, or the Hand hills, which are 800 feet above the surrounding plain, become pronounced topographic features.



Model in relief of country between the foothills and Lake Winnipeg. Model by D. B. Dowling.

Fourth Division. The topography of the foothills is much more diverse than that of the other three previously discussed areas. From the south the foothill area gradually widens to the north, and in the valley of the Crowsnest river, as it emerges from the mountains, the erosion has narrowed the foothill belt to a few miles.

The illustration (Plate IV)—introduced to show the chief features of the topography—is from a photograph of a model in which the relief is exaggerated somewhat to bring out the less prominent hills and valleys. It also has a bearing on the fuel problem. The southern part is mostly bare prairie with a fringe of true forest—shown in the picture as a darker shaded portion—along the north, and covering most of northern Manitoba. Park-like, partly open patches of poplar and some spruce, invade the prairie section from the forest edge. About half the area illustrated is true prairie, where the fuel supply for the settler will be local coal.

MEANS OF COMMUNICATION.

The natural means of communication by waterways is restricted to the navigation of some of the lakes in Manitoba, and the streams crossing the plains. The streams are navigable only at high water and they all have strong currents; hence the difficulties of navigation from shallow water and current combined are so great that overland transport is necessary. This is being supplied by the railway lines which traverse the area generally in an east and west direction. The main line of the Canadian Pacific railway was the first through line connecting the eastern and western portions of Canada. It crosses the Rocky mountains by the Bow River valley through the Kicking Horse pass. Subsequently, branches from St. Paul to Moosejaw, and from Medicine Hat to Kootenay Landing, passed through the coal mining districts of Souris river and the Crowsnest pass. Two transcontinental lines now building—the Canadian Northern and the Grand Trunk Pacific—reach from Winnipeg to the mountains. A third line—a branch of the Canadian Pacific—is also completed to Edmonton. Transverse roads are also included in the present general scheme: such as the railway from Edmonton to Calgary; that from Calgary to Macleod; and

Macleod to a connexion in Montana. Another transverse route is provided by the Canadian Pacific and Canadian Northern branches from Prince Albert to Portal, on the Dakota boundary. The third set of transverse roads includes a number in Manitoba. An outlet to Hudson bay is also being located from the lower part of the Saskatchewan.

The coal fields of the mountains are at present served by the Crowsnest and main branches of the Canadian Pacific railway for the Crowsnest, Coleman, Blairmore-Frank, and Cascade areas; by the Canadian Northern railway for the Shunda area on the Saskatchewan and the Brule Lake and Moose Creek areas on the Athabaska; and the Grand Trunk Pacific railway for Nikanassin and Roche Miette areas on the McLeod and Athabaska rivers respectively.

GENERAL GEOLOGY.

GENERAL STATEMENT.

At the eastern edge of Manitoba, and extending northwesterly, appears the old Pre-Cambrian plain on which, to the southwestward, is laid successive beds of Palæozoic limestones, in their turn covered by heavy deposits of shales and sandstones, mainly of Cretaceous age though remnants of Tertiary deposits are found on this Cretaceous plateau. The Palæozoic rocks which disappear under this mass of shales along its eastern edge appear again in the Rocky mountains by faulting, and their load of softer rocks is there almost all removed, leaving traces only of the lower members in some of the valleys.

The formations exposed in this part of the continent, therefore, range in age from the rocks of the Pre-Cambrian complex, thr ıgh the Palæozoic and Mesozoic, to the Cenozoic. As before remarked, lying on the Pre-Cambrian floor in Manitoba are exposed limestones correlated with the Ordovician and Devonian of other parts of the continent. These consist mainly of dolomitic beds that are flat-lying, and form inconspicuous topographic features. In the Rocky mountains, in addition to this series, limestones and calcareous shales of Carboniferous age occur.

The Mesozoic section is complete only in the vicinity of the mountains. The lower beds—red sandy shales—have been found north of the Saskatchewan to contain Triassic fossils. This red series is in turn covered by dark shales of marine origin, with fossils of a Jurassic type. They are everywhere found beneath the lowest coal measures, which are assigned to the Cretaceous, and form narrow belts running parallel to the ranges. No exposures of these Jurassic rocks are known east of the foothills.

TABLE OF

Groups.		Alberta.	Saskatchewan	Manitoba
Tertiary	Oligocene	Hand Hill beds	Cypress Hill beds	
	Eocene	Paskapoo	Fort Union?	Fort Union?
Cretaceous		Edmonton	Lance?	Lance?
	Montana	Pierre Bearpaw	Pierre	Odanah
		Brazeau Belly River	Belly River	
		Lower Dark shales		
		Claggett Wapiabi		Millwood
	Colorado	Bighorn Cardium Niobrara		Niobrara
		Benton		Benton
	Dakota	Dakota Blairmore		Dakota
	Kootenay	Kootenay		
Jurassic		Fernie		
Triassic and Permian		Upper Banff shale		
Carboniferous		U. Banff limestone L. Banff shale		
Devonian		L. Banff limestone Intermediate series		Manitoban Winnipegosan

FORMATIONS

Montana	Dakota	Kind of Rocks	Character of Fossils	Economic Value
Fort Union	Fort Union	Conglomerates and sandy clays	Land and fresh water	Building stone
	Lance	Sandstones and clays	Land plants Brackish water	Coal
Foxhill	Foxhill	Sandstones and clays		
Bearpaw Judith River		Shales Sandstones	Marine Brackish and fresh	Coal
Claggett Eagle	Pierre	Shales Sandstones	Marine Marine	
Niobrara	Niobrara Greenhorn	Calcareous shales	Marine	
Benton	Benton Graneros	Shales	Marine	
Dakota	Dakota	Sandstones	Fresh water	Some coal
Cascade Kootenay	Fuson Minnewaste Lakota Morrison	Sandstones and shales	Land plants	Coal
Ellis	Unkpapa Sundance	Shales and sandstone	Marine	
	Spearfish	Red shale	Marine	
Quadrant Madison	Minnelusa Pahaspa	Limestones and quartzites	Marine	Lime and cement
Monarch		Limestone	Marine	Lime and cement

The Lower Cretaceous consists of sandstones, and brown and black shales, in which are numerous coal seams. These rocks do not appear east of the foothills. The thickness of the formation increases westward, and is at its maximum in the Elk River valley, where it has a thickness of about 5,000 feet.

The middle part of the Cretaceous, consisting of shales of marine origin, forms the plateaus extending from the mountains to within the borders of Manitoba. The general topography, with its deeply incised valleys, is derived mainly from the erosion of these soft rocks.

The upper part of the Cretaceous section, although for the most part marine shales, grades upward to sandy measures of brackish water origin. The harder beds of this upper part form many of the stronger topographic features, both of the foothills and plains. Few exposures are to be found in the mountains, where they have been almost entirely removed by erosion.

The Tertiary rocks are littoral deposits—sandstones with some shales and conglomerates. Exposures are to be found in the higher plateaus such as the Cypress hills and Wood mountain, and in the trough which extends north from the International Boundary in the foothills, including the Porcupine hills, and the sandstones at Calgary. The northern extension crosses the Saskatchewan west of Edmonton.

The later deposits, such as the glacial till and the Saskatchewan gravel, need be but briefly mentioned. The glaciation of the mountains spreads a mantle of till through the foothills. The till of the Keewatin glacier does not always reach the eastern margin of the Rocky Mountain till, and they are possibly of two distinct periods. The eastern-derived till is thin on the uplands, and often appears to have been rearranged by deposition in water. Morainic deposits occur on the Coteau in eastern Saskatchewan, and in Manitoba. Glacial lake phenomena have been observed at several parts; the Lake Agassiz beaches of Manitoba, and the upper Red river have formed the subject of several interesting reports.

SUMMARY DESCRIPTION OF FORMATIONS.

Devonian.

In Manitoba, the Devonian rocks are divided into three series, Upper, Middle, and Lower.[1]

Upper Devonian or Manitoban—

Light grey, hard, brittle limestone with red argillites at base—thickness about 200 feet.

Middle Devonian or Winnipegosan—

Light yellow, hard dolomite, with porous beds beneath—thickness about 200 feet.

Lower Devonian—

Mainly red shales—thickness about 100 feet. These beds probably represent only the upper part of the lower Devonian of eastern America.

In western Saskatchewan these beds are be found near the Churchill river: having nearly the same characters.

In Alberta, the most eastern exposure of the Devonian is in the neighbourhood of Athabaska river. In the Rocky mountains they form the *Intermediate series* described by R. G. McConnell as being brownish, irregularly hardened dolomites, and greyish, crystalline dolomites, with some sandstones and quartzites.

Carboniferous.

As will be seen by the table of formations, Carboniferous rocks are found in South Dakota, Montana, and Alberta. They are not exposed in Manitoba or along the northwest margin of the Cretaceous plateau, but are confined to the Rocky Mountain uplift. They have been subdivided on lithological characters into Upper and Lower Banff limestones. These formations are each capped by shaly beds, from which have been obtained a few characteristic fossils. The formation is generally a bluish limestone, and forms the summits of Cascade and Rundle mountains, near Banff. A thickness of over 6,000 feet has been observed for the formation in the Bow valley.

[1] Geol. Surv., Can., Ann. Rept., Vol. V, pp. 204–205 E.

Permian and Triassic.

A series of red, sandy shales, capped by a thin bed of yellow dolomitic limestone, exposed along the western slopes of many of the ranges, occurs at Banff, and has been called the Upper Banff shale. Few fossils were be found at this locality, in these measures; but in their continuation north to the Brazeau, several shells resembling *Monotis* indicate a correlation with the Triassic rocks of the Peace and Pine rivers.

Jurassic.

Fernie Shale.

In the locality where this formation received its name—near Fernie, B.C.—it consists of a series of black and brownish shales, 1,060 feet in thickness, overlying 500 feet of sandy argillites. Eastward, through the Crowsnest pass, the series decreases in thickness, and at Blairmore, near the edge of the mountains, there is only 700 feet. On the Cascade river the section is 1,600 feet, and consists of black shales and grey sandstones, with an occasional limestone bed towards the base. In the Moose Mountain area—an outlier of the Rockies—the thickness is only 225 feet. The formation has been traced northward to the Athabaska river, and preserves its general black, shaly appearance. Few fossils have been obtained in these measures, but those obtained are characteristic.

From near Fernie, Dr. Whiteaves described[1];—*Cardioceras canadense.*

From Minnewanka lake, Mr. McConnell[2] collected;—*Terebratula robusta; Ostrea skidegatensis; Exogyra* sp.; *Lima perobliqua; Pteria (Oxytoma) corneuiliana; Trigonoarca tumida; Trigonia dawsoni; Astarte carlottensis; Protocardia hillana; Cyprina occidentalis; Pleuronomya carlottensis; Schlænbachia borealis; Schlænbachia gracilis.*

The above list shows a remarkable similarity to the fauna of the "Lower Shales" of the Queen Charlotte Island series. Messrs. Stanton and Martin place this fauna well down in the Jurassic.[3]

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[1] *Ottawa Naturalist*, Vol. XVII, p. 65.
[2] Geol. Surv., Can., Cont. to Can. Pal., Vol. I, part 2, p. 163.
[3] Bull. Geol. Soc. Am., Vol. 16, p. 402.

On the Red Deer river, within the mountains, exposures are found containing great numbers of Bellemnites, and one small Ammonite described by Dr. Whiteaves[1] under the name *Peltoceras occidentale*. This is regarded as a purely Jurassic form.

On the headwaters of Ram creek, a thin limestone band in the formation was found to contain many small reptilian bones and teeth.

Cretaceous.

Kootenay.

The lower member of Cretaceous, the Kootenay, is found resting upon the Jurassic in the Rocky mountains. In Manitoba it has not been recognized, and is supposed to have formed but a very thin sheet to the east. It is recognized in the southern part of Dakota, and in Montana. In the Rocky mountains the base of the formation is a heavy bed of sandstone, which is succeeded by sandstones and shales containing many coal seams. The maximum deposition during this period was near the axis of the Rocky mountains. In the Elk River escarpment the formation measures 3,600 feet. East of this, at Blairmore, it is reduced to 740 feet. North, near Banff, it has a thickness of 3,900 feet; and in Moose mountain, east of the main range, there are only 375 feet. Northward, on the Bighorn, the thickness is about 3,600 feet.[2] It would seem that east of the mountains the formation was not of great importance, owing to thinning of the beds. The fossils of the formation so far described are plants—ferns, cycads, and conifers.

Dakota.

In the mountains, above the coal-bearing Kootenay, occurs a series of conglomerates and sandstones that have a newer flora. The measures are not distinctly coal-bearing, though a few thin seams are found. Fresh water conditions during the deposition of this series prevailed in Dakota and Montana, and probably along the western margin; but northward, on the Athabaska river, the Tar sands representing a period contemporaneous with the Dakota of Manitoba, have a marine fauna[3].

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[1] *Ottawa Naturalist*, Vol. XXI, p. 80.
[2] Geol. Surv., Can., Memoir 9.
[3] *Ottawa Naturalist*, Vol. XII, p. 37.

The thickness of the formation in Manitoba cannot be much over 200 feet.[1] In the foothills a thickness of 150 feet seems to represent the formation; but westward, in the Elk River valley, a much greater thickness of coarser material is found.

Benton.

The Benton consists of dark grey, almost black, shale of marine origin. In Manitoba[1] the deposit is about 175 feet in thickness. In the foothills it is over 700 feet, but this undoubtedly includes the overlying Niobrara. Very few forms of animal life appear in these measures, but in Alberta they include such forms as *Inoceramus problematicus, Scaphites ventricosus, Prionscyclus woolgari.*

Niobrara.

In Manitoba,[2] the Niobrara formation consists of grey calcareous shales, and is an upward continuation of the Benton beneath. The thickness varies from 130 to 200 feet, though it is apparently much thicker in places. The upper part is rich in calcite, and is used in making a common grade of cement in Manitoba. The presence of Foraminifera is a characteristic feature of the formation. The fossils include *Serpula semicoalita, Ostrea congesta, Anomia obliqua, Inoceramus problematicus, Belemnitella manitobensis, Loricula canadensis, Ptychodus parvulus, Lamna manitobensis, Enchodus shumardi,* and *Cladocyclus occidentalis.*

Eagle.

In the foothills the only exposure that can be correlated with the Eagle sandstone of Montana, is a thin 50 foot bed of light coloured sandstone.

Claggett.

The "lower dark shales" of Dawson in the Milk River region of southern Alberta—marine in origin, and holding

[1] Geol. Surv., Can., Ann. Rept., Vol. V, pp. 209-210 E.
[2] Geol. Surv., Can., Ann. Rept., Vol. V, pp. 210-212 E.

fossils which are mainly the same as in the Pierre—have, in that locality, been given a thickness of 800 feet. In Manitoba—the lower part of the Pierre—the Millwood shales may represent this deposition. The fossils here found include a number of radiolaria, and *Pteria linguiformis, Inoceramus tenuilineatus, I. sagensis, Lucina occidentalis, Entalis paupercula, Dentalium gracile, Baculites compressus, Scaphites nodosus, Hylobites cretaceous,* and fragments of fishes.

Belly River.

A formation found in northern Montana and claimed to be the Judith River formation is found to continue north into Alberta, and to constitute there the beds called "Belly River." No exposures occur east of Saskatchewan; but if the divisional line between the two portions of the Pierre in Manitoba marks the horizon occupied by them, there may yet be found thin beds of this horizon to the east of those now known. The formation is represented in the north, on Peace river, by the Dunvegan beds. In Alberta it is described as consisting of two divisions: an upper pale series, and a lower yellow part. In the upper, brackish water mollusks are found, and the strata consist mainly of fresh water deposits. The lower portion is distinctly yellowish in colour, and is mainly a brackish water formation.

The rocks are sandy clays with shales and sandstones, and the total thickness of the formation seems to be 900 feet. The thickness of the part exposed in Alberta may be not far short of 900 feet, though it evidently thins out eastward.

Coal seams occur in the upper or fresh water portion, and the fauna resembles very closely that of a Tertiary type in beds above. The most characteristic mollusk found is *Corbula perundata,* which is absent from the formation above. The collections from these beds include the following: *Ostrea glabra, Ostrea subtrigonalis, Mytilus subarcuatus, Anadonta propatoris, Unio primævus, Unio consuetus, Sphærium formosum, Corbula subtrigonalis, Corbula perundata, Physa copei, Viviparus conradi,* with many vertebrate remains for which see Contribution to Canadian Palæontology, Vol. III.

Bearpaw.

The Pierre-Foxhill of the writers of the geology of Saskatchewan and Alberta, is without doubt that portion of the Pierre which is above the Belly River formation; but since it has been shown that the typical Pierre embraced beds below this shallow water and land deposit, new names have been suggested by Messrs. Stanton and Hatcher—Claggett for the lower shales, and Bearpaw for the upper. Few fossils have been obtained in Canada from the Claggett; but the Bearpaw, a similar grey clay shale, is found to be very rich in remains of animal life. A partial list only can be inserted here: *Lingula nitida, Ostrea patina, Pteria linguiformis, Inoceramus altus, I. nebrascensis, I. tenuilineatus, Modiola attenuata, Voldia scitula, Lucina occidentalis, Cyprina ovata, Protocardia subquadrata, S. borealis, Mactra gracilis, Anisomyon centrale, Baculites compressus, Baculites grandis, Scaphites nodosus, Placenticeras placenta.*

In Manitoba, the upper part of the Pierre is called Odanah, and may represent the same time interval as the Bearpaw.

Edmonton.

The Laramie rocks of the former maps of southern Saskatchewan are, over a large part, divisible into two distinct divisions. The lower one consists of about 150 feet of feebly coherent, greyish, and pure white clays, sandy clays, and sands with occasional beds of carbonaceous shales and lignites.[1] This lower unnamed part bears the same relation to the marine clays of the upper Pierre that the Edmonton of Alberta does, and is here correlated with it.

In Alberta, the rocks of the southern part described as Laramie are divided into three divisions, and the lower part of the lowest member—the St. Mary River beds—is of about the same horizon as the Edmonton of northern Alberta. It is distinctly a series of light coloured clays and sands, and contains numerous coal seams. The deposits form a brackish water transition series between the marine clays of the upper Pierre or Bearpaw, and the Tertiary, or purely fresh water formation.

[1] Geol. Surv., Can., Annual Report, Vol. I, 1885, p. 67 C.

The fossils consist of Dinosaurian remains, with land plants, and the following brackish-water forms: *Ostrea glabra, Unio danæ, Corbicula occidentalis, Panopæa simulatrix, P. curta.*

The thickness of the formation varies, but attains a maximum of 700 feet in central Alberta.

Tertiary.

Paskapoo.

This series consists of fresh water deposits, generally of yellowish sandstones and bluish grey and olive sandy shales. It embraces the upper part of the Laramie of southern Alberta, with a total thickness of about 5,700 feet. The remains of plants are numerous, and denote a flora of a temperate climate.

The fresh water fossils include: *Unio danæ, Sphærium formosum, Limnæa tenuicostala, Physa copei, Acroloxus radiatulus, Thaumastus limnæiformis, Goniobasis tenuicarinata, Campeloma productus, Viviparus leai, Valvata filosa, V. bicincta.*

Fort Union.

In southern Saskatchewan the lignite-bearing beds of the Souris valley and the higher lands west, appear to have in their upper portions, fresh water deposits that are lower Tertiary in age. The fossils include: *Unio priscus, Corbula mactriformis, Thaumastus limnæiformis, Goniobasis nebrascensis, G. tenuicarinata, Campeloma productum, C. multilineatum, Viviparus trochiformis, V. leai, V. conradi;* and the following plants, *Platanus heterophyllus, P. nobilis, Sassafras selwyni, Quercus* sp., *Taxites olriki, T. occidentalis.*

Oligocene.

Isolated exposures of coarse grained material deposited on the eroded surface of the lower Tertiary (in northern Alberta the Paskapoo series) have been found to contain a considerable number of mammalian bones. These beds are characterized by the great quantity of waterworn pebbles derived from the quartzites of the Rocky mountains.

STRUCTURAL AND HISTORICAL GEOLOGY.

The structure of the region can only be briefly outlined. The subsidence during Palæozoic time, of parts of the central continental area, is shown by the marine limestones outcropping in Manitoba and the Rocky mountains. The depressions in which the Mesozoic rocks were deposited first appeared in the longitude of the Rocky mountains, and Triassic and Jurassic deposits are there found. Early Cretaceous depositions occur in the same district following a shallowing of the sea, in which very little of the present continent was submerged. The unconformity between the Cretaceous and the Palæozoic floor on which it was laid down, is shown by the varying time intervals of non-deposition there recorded. Thus, in Manitoba, Dakota beds lie on upper Devonian. In Stearns county, Dakota, the floor is Pre-Cambrian; but on the southwest border, Jurassic, and probably Lower Cretaceous, are separated by a probable unconformity. On the Athabaska river, marine beds of Dakota age rest on Devonian; while in the Rocky mountains there seems to be no visible break in the section through Carboniferous, Triassic, and Jurassic, to the lowest known horizon of the Cretaceous. The floor then, on which the Cretaceous was laid down, was probably a plane of erosion, over which the formations occupy successive bands; the newer beds being those on the west.

The Cretaceous covering appears also to have been deposited in a somewhat irregular manner owing to crustal movements. The Jurassic and Lower Cretaceous do not appear to have covered the whole area, and indicate that the Jurassic sea invaded the area along a narrow depression, now elevated in the foothills and Rocky mountains. Land conditions prevailed throughout portions of the early Cretaceous, but the occasional submergence extended a short distance east of the mountains, and in the United States to the south appears to have extended as far as the Black hills and part of Montana. The greatest amount of detrital matter is to be found, and evidence also of an abundant flora, along the western portion of this early Cretaceous depression.

A more general subsidence brought the sea farther northeast during Benton time, and covered the sandy deposits of

the Dakota with a series of dark, marine shales. In the western sections there is evidence of a possible shallowing at the top of the Benton; but in the east the sea continued to the close of the Niobrara.

The deposits of the Montana group indicate marine conditions; but its inception shows shallow water along the western margin. In the east, deeper water prevailed throughout. A shallowing of the western part occurred about the middle of this period, land conditions are there apparent and land plants appear—preserved in coal seams. This area was again invaded by the sea, and these sandy deposits were covered by marine shales. The close of the Cretaceous is marked by an emergence from the sea; but during the periods of oscillation between land and shallow water conditions—when the surface remained near sea-level—an abundant flora appears along with brackish water forms of animal life. The coal-bearing beds of this phase of the retreat of the sea have been called the Edmonton formation in northern Alberta, and the St. Mary River series in southern Alberta.

Toward the close of the Paskapoo period the transfer of the great mass of deposits that had proceeded through Cretaceous times, began to unsettle the equilibrium of the area from which they had been derived, and the crustal movements which ended in the forcing up of the Rocky mountains then commenced.

This movement seems to have been caused by a great lateral force shoving the crust from the southwest, and anticlinal ridges no doubt appeared, but soon developed into fault lines along which the Palæozoic floor was pushed up from the west, to form the mountain ridges. The amount of this displacement decreases in the ranges toward the east, and in the foothills brings only the middle Cretaceous beds to the surface.

The erosion of the ridges thus formed supplied much of the material found in the Oligocene beds. The conglomerates of the upper portions are apparently derived from the quartzites of the mountains.

ECONOMIC GEOLOGY.

GENERAL STATEMENT.

The economic value of the rocks of the Cretaceous, exposed as they are over an enormous area, lies chiefly in their coal-bearing beds. Although mainly sea deposits there are three horizons which show land conditions and evidences of plant life, and in these beds coal seams have been found.

A marine invasion of the central part of the continent during Cretaceous time was preceded in the then existing low trough of the present Rocky Mountain area, by an abundant flora, so that the early Cretaceous was coal-bearing.

These beds—known as the Kootenay series—were subsequently covered with a series of marine shales deposited by an invasion of the sea; but a shallowing of this sea over the western part also brought about land conditions again in later Cretaceous time, and vegetation spread eastward, which was in turn buried by shales in the last invasion by the sea. This second flora is preserved in the beds of the Belly River formation, and in places forms important coal deposits.

At the close of Cretaceous time, when the continent finally emerged from the sea, and while the land surface oscillated slightly at or near sea-level, another mantle of vegetation covered the low ground. Coal seams were then formed, and in the rocks which succeed these coal beds, impressions of leaves, stems, and petrified wood, show an increasingly changeable climate, and probably an increasing altitude.

The last deposits of the Cretaceous form the third coal horizon, and a fourth occurs in the fresh-water of the early Tertiary.

GENERAL CHARACTER OF THE COALS.

As is often found, the character of the coal varies with the age of the formation, and the amount of the covering beds. In this case the general law holds, but a far more important

element has also influenced the alteration. The lateral disturbance and pressure in the formation of the Rocky mountains has made a great change in the character of the coal.

Tertiary—Edmonton Coals.—In the undisturbed regions the coals are lignites, but grade from those bordering on true coals in the west to poor lignites having 20 per cent of moisture. In the disturbed area this formation contains coals that grade up from good lignites to true coals.

Belly River Coals.—In the undisturbed areas the coals grade from true coal to lignite, as in the series above, but are generally of better class. In the disturbed belt they border on coking coals.

Kootenay Coals.—As these are in the lower measures, and have been subjected to greater load, they are, as would be expected, of higher grade, but as the exposures are all in the broken and faulted blocks of the mountain area, a much greater change has taken place than would be expected in undisturbed beds. The coals range from coking coals to anthracites. The anthracitic area is that of the Cascade basin—the greatest alteration being found near Banff.

FLORA OF THE CRETACEOUS AND TERTIARY COAL MEASURES.

The flora of the Cretaceous has formed the subject of many papers, mainly from the pen of Sir J. W. Dawson, supplemented by later studies by Professor D. P. Penhallow. The main economic value of these rocks is, without doubt, their coal contents; and although the whole land flora is not supposed to have entered into the composition of the coal beds, it is proposed to briefly summarize the general character of this flora.

The earliest Cretaceous plants appear in the Kootenay series, and although—according to Sir J. W. Dawson—there seems to have been a few species of a Jurassic aspect, the majority are to be correlated with those of Cretaceous beds elsewhere, and, therefore, the facies of the flora of the formation as a whole show a decidedly early Cretaceous aspect.

Kootenay Formation.

From the type locality of the Kootenay in the Elk River valley have been obtained: *Dicksonia* sp., *Asplenium martinianum, A. Dicksonianum, A. Distans, Dioonites borealis, Podozamites lanceolatus, Zamites montana, Z. acutipennis, Anomozanites acutiloba, Sphenozamites* sp., *Antholites horridus, Salisburia (Ginkgo) sibirica, S. lepida, S. nana, Baiera longifolia, Pinus suskwaensis, Sequoia smittiana, Glyptostrobus grœnlandicus, Taxodium cuneatum.*

F om Canmore and Anthracite: *Asplenium martinianum, Zamites montana,* and *Dioonites borealis, Equisetum lyellii, Angiopteridium canmorense, Pectopteris browniana, Cladophlebis falcata, Aspidium fredericksburgense, Leptostrobus longifolius, Pinus nordenskioldii, P. anthraciticus, Sphenolepidum pachyphyllum.*

The formation at Moose mountain contains the following: *Dryopteris fredericksburgensis, Cycadites longifolius, Sagenopteris mantelli, Athrotaxopsis tenuicaulis, Sagenopteris,* n. sp., *Thyrsopteris meekiana, Sequoia heterophylla, Sequoia smittiana, Sagenopteris elliptica, Baieropsis pluripartita, Podozamites longifolius, Podozamites lanceolatus, Thyrsopteris insignis, Thyrsopteris pecopteroides, Cladophlebis falcata, Zamites arcticus, Ginkgo huttoni magnifolia, Cladophlebis constricta, Cladophlebis distans, Nilsonia,* n. sp.

In the foothills traces of a flora intermediate between the Kootenay and Dakota are found in the Mill Creek beds and in the Moose Mountain section, which is there assigned to the Dakota.

Dakota and Transition Beds.

The Mill Creek flora embraces the following forms: *Cleichenia gracilis, G. Kurriana, Dicksonia munda, Asplenum albertum, Williamsonia recentior, Platanus heeri, P. affinis, Liquidambar integrifolium, Alnites insignis, Macclintockia cretacea, Proteoides daphnogenioides, Cinnamomum canadense, Laurophyllum debile, Laurus crassinervis, Aralia rotundata, Aralia westonii, Hedera ovalis, Magnolia magnifica, Paliurus montanus, Paliurus ovalis, Juglandites cretacea.*

From the Moose Mountain section of the Dakota beds the following forms have been determined: *Carpolithus ternatus,*

fruits, probably of Ginkgo, *Sphenolepidium sternbergianum densiflorum, Ginkgo lepida, Ginkgo sibirica, Ginkgo,* sp., male inflorescence, *Athrotaxopsis tenuicaulis, Nilsonia californica, Ginkgo huttoni, Thyrsopteris brevipennis.*

Belly River Formation.

From banks of the Belly River, in the Belly River formation have been obtained: *Pistia corrugata, Lemna scutata, Brasenia antiqua, Populus latidentata, Acer saskatchuense, Sequoia reichenbachii.*

From Pine and Peace rivers: *Asplenium niobrara, Cycadites unjiga, Carpolithes horridus, Glyptostroba gracellimus, Sequoia reichenbachii, Torreia dicksonoides, Ficus maxima, Fagus proto-nucifera, Laurophyllum debile, Protoides longus, Betula* sp., *Populites cyclophylla, Diospyros nitida, Magnolia tenuifolia, M. magnifica, Menispermites reniformis, Protophyllum leconteanum, P. boreale, P. rugosum.*

From Moose mountain: *Populus elliptica, Betulites* sp., *Dioonites* sp., *Asplenium niobrara, Athrotaxopsis tenuicaulis, Asplenium dicksonianum, Thyrsopteris pecopteroides, Protophyllum haydenii, Cissites* sp., *Ginkgo baynesiana, Ginkgo sibirica, Paliurus cretaceus, Paliurus ovalis, Salix* sp., *Quercus rhamnoides, Juglans crassipes, Angiopteridium strictinerve* (?), *Sphenopteris johnstrupi, Sequoia smittiana, Sequoia cuneata, Sequoia reichenbachi, Sequoia ambigua, Alnites grandifolia.*

Many of these forms are of a Dakota type, but the formation seems to be situated above the horizon of the Colorado group.

Edmonton Formation.

The following plants have been collected from the Edmonton formation: *Abietites tyrrellii, Sequoia reichenbachii, Platanus newberryana, Taxodium occidentale, Taxites olriki, Lemna (Spirodella) scutata, Platanus nobilis, Castanea* sp., *Sapindus affinis, Æsculus antiqua, Trapa borealis, T. microphylla.*

Paskapoo Formation.

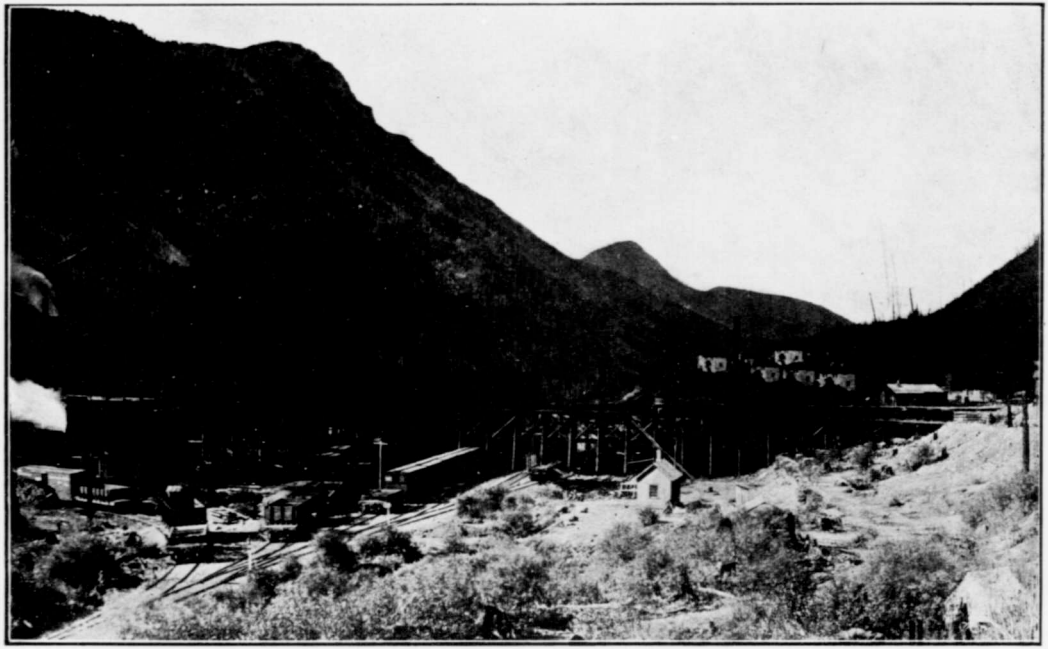
The flora of this formation has been preserved in the sandstones as leaves and fossilized woods; coal seams occur, but not in as great number as in the Edmonton. As the plants are

scattered through the formation a greater variety have been found, many of which possibly may be found in the lower part and in the Edmonton. The list is a long one, but has not been compiled hitherto into one. The determinations are by Sir J. W. Dawson and D. P. Penhallow.

List of Tertiary plants: *Onoclea sensibilis, Sphenopteris guyottii, 'S. blomstrandi, Lastrea fisheri, Davallia (Stenoloma) tenuifolia, Equisetum arcticum, Thuga interrupta, Sequoia couttsii, S. nordenskioldii, S. langsdorfii, Glyptostrobus europeus, Podocarpites tyrrellii, Taxodium occidentale, T. distichum miocenum, Taxites olriki, Lemna (spirodella) scutata, Phragmites* sp., *Scirpus* sp., *Platanus nobilis, P. raynoldsii, Castanea* sp., *Quercus* sp., *Q. ellisiana, Glyptostrobus europeus, Typha* sp., *Majanthemophyllum grandifolium, Clintonia oblongifolia, Populus ungeri, P. obtrita, P. daphnogenoides, P. richardsoni, P. acerfolia, P. arctica, P. genetrix, P. nervosa, Salix rœana, S. laramiana, Sassafras selwynii, Corylus americana fossilis, C. macquarrii, Alnites grandifolia, Carya antiquorum, Juglans leconteana, J. rugosum, J. schimperi, J. rhamnoides, J. occidentalis, J. laurifolia, J. acuminata, Viburnum ovatum, V. saskatchuense, V. asperum, V. calgarianum, V. oxycoccoides, V. lanceolatum, Sapindus affinis, Æsculus antiqua, Symphorocarpophyllum albertum, Paliurus columbii, Cornus rhamnæfolia, Cercis parvifolia, Phyllites venosus, P. carneosus, P. caparinoides, Nelumbium sakatchuense, Trapa borealis, Catalpa crassifolia.*

Fort Union Formation.

In Saskatchewan a number of plants were collected by G. M. Dawson in 1874 while naturalist on the Boundary Commission. The determinations are by Sir Wm. Dawson and are published as appendix A to the Report on the Geology and Resources of the Forty-ninth Parallel by G. M. Dawson. The list includes the following: *Onoclea sensibilis, Davallia (Stenoloma) tenuifolia, Equisetum* sp., *Physagenia parlatii, Glyptostrobus europaeus, Sequoia langsdorfii, Thuja interrupta, Lemna (Spirodela) scutata, Pragmites* sp., *Scirpus* sp., *Populus richardsoni, Salix raeana, Corylus rostrata, C. americana, Platanus heterophyllus, Diospyrus* sp., *Sapindus affinis, Rhamnus concinnus, Carya antiquorum, Juglans cinera? Viburnum pubescens, Aesculus antiquus, Trapa borealis, Carpolithes* sp.



Coal Creek coal mine, Fernie, B.C., 1900.

CRETACEOUS COALS.

KOOTENAY FORMATION.

General Statement.

The Kootenay being at the base of the Cretaceous, and near the limestone beds which represent the Carboniferous and Devonian, is exposed only in and near the Rocky mountains. The faults and uplifts which bring up the limestone beds have also elevated these coal measures, but a great part has been denuded. As the general system of mountain building for the outer ranges of the mountains is a series of fault blocks dipping mostly to the west, these blocks often have remnants on their rear slopes, of the overlying Kootenay, and the coal measures are usually to be found against the next succeeding fault block. Within the mountains the coal fields are generally found in long narrow strips between the ranges. The thickness of the formation which is coal-bearing reaches a maximum in the Elk River valley of 3,600–4,000 feet, in which there are twenty-two workable seams. The minimum is to the east, and in the foothills has been found to be not much over 200 feet, with only three good coal seams. In addition to the Alberta areas the Kootenay is also found on the western slope within the Province of British Columbia. This is the Elk River or Crowsnest field—perhaps the most important in Canada.

The Alberta areas are not individually as extensive, but are distributed from near the International Boundary to north of the Athabaska river.

The base of the Kootenay is generally marked by a heavy bed of sandstone, above which is a succession of sandstones and shales rich in coal seams, varying in thickness in the different fields. The top of the formation where the coal seams are found, is marked by coarse conglomerate in the southern areas, but finer toward the north.

British Columbia Areas.[1]

The areas in British Columbia, on the Elk river, are divided into two portions. The southern one—for which Fernie is the

[1] Geol. Surv., Can., Sum. Rep., 1900, pp. 85–95.
Geol. Surv., Can., Sum. Rep., 1901, pp. 75–79.
Geol. Surv., Can., Sum. Rep., 1905, pp. 59–60.
Geol. Surv., Can., Coal Resources of the World, 12th Int. Geol. Congress, pp. 493–494.

largest shipping point—has a length north and south of about 30 miles, and a maximum width of 12 or 13 miles, with an estimated area of 230 square miles. The coal-bearing rocks have in several sections been found to have a thickness as great as 4,000 feet. In this area there are twenty-two workable seams, with a total of 216 feet of coal, 100 feet of which are estimated as workable. This would give a total workable coal content for the district of 22,600,000,000 tons. Considering, however, that at some future time smaller seams will be mined, this estimate is very conservative and a larger reserve is probable. In the section at Morrissey, in 3,676 feet of measures, 23 seams have an aggregate thickness of 216 feet. At Fernie, in 2,250 feet of measures, there is 172 feet of coal in seams over 1 foot thick, with a probability of other concealed seams beneath; and in the Sparwood section, 216 feet of coal is contained in 4,065 feet of measures. There is, therefore, a fairly constant aggregate of 172 feet and the total coal content has been estimated at 43,336,342,000 tons.

The coal is a high grade bituminous, occasionally running into anthracitic. The majority of the seams are used for the manufacture of coke, but steam coal is a product as well. The collieries are situated at Coal Creek, near Fernie, Michel, Morrissey, and Hosmer.

The northern part of the Elk River coal field extends from about 24 miles north of Michel creek, to the height of land at the Kananaskis river, a distance of nearly 40 miles. The width does not exceed 7 miles as a maximum, and toward the north diminishes to a vanishing point at the source of the Kananaskis. The area has been computed to be about 134 square miles, and the number of workable coal seams is large. In one place, Aldridge creek, for example, it is estimated at 16 square miles, with a total thickness of 163 feet of coal. The southern portion of this strip is also narrow, and as all the measures are probably not present, the coal content is much lessened and the estimated thickness of coal varies from 60 to 80 feet. In the broader portions as great a thickness as 182 feet has been found. The estimate by small areas with the thicknesses found, gives a total for these in the upper Elk valley of 12,941,000,000 tons.

Southward from the Crowsnest field, outliers of the coal-

bearing measures are found on Flathead river, the largest occurring on the west side of the valley about 12 miles north of the International Boundary. A series of low wooded hills surrounded by limestone mountains, forms a basin of small extent that may be a fault block. The eastern outcrop shows beds dipping west 20° and seams 20 feet, 30 feet, 16 feet, and 50 feet thick, are exposed. This area is now being prospected and promises to prove a valuable field though it may be broken by faults or folds. The coal is bituminous and apparently clean.

A block of similar rocks is found, on edge, farther north in the valley, and has been traced by following a 50-foot seam, for about 2 miles, but owing to the nearly vertical attitude of the seam, this area will not produce as much coal as the first mentioned locality. A third outlier occurs near the North Kootenay pass in the form of a narrow strip of northerly dipping beds, cut off or upturned on the north against an upthrust limestone block. Several seams have been found in the belt.

Alberta Areas.

The areas in Alberta crossed by the Crowsnest branch of the Canadian Pacific railway within the mountains, including those mined at Coleman, Frank, Lille, Belleview, and several other collieries, are discussed under the two following headings.

Coleman Area.[1]

The Coleman area is a narrow belt, or fault block, with the measures dipping to the west. It can be considered to have a breadth of $1\frac{1}{2}$ miles, and its longitudinal extension, although not definitely known, is approximately 30 miles.

Coal occurs in about 500 feet of the measures, but the important seams lie within a thickness of about 300 feet. Three of the principal seams are 16 feet, 10 feet, and 8 feet thick respectively, all dipping to the west.[2]

[1] Geol. Surv., Can., Sum. Rep., 1902, pp. 167–179.
[2] Geol. Surv., Can., Sum. Rep., 1911, pp. 192–200.

Blairmore-Frank Area.

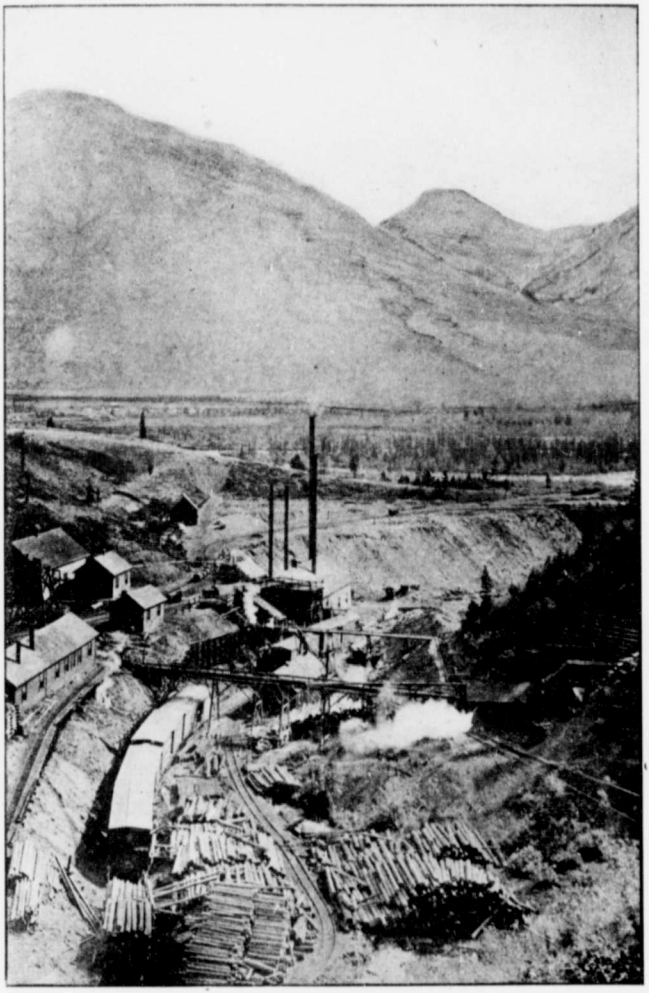
The Blairmore-Frank area lies in a large fault block, broken by many vertical faults and folds, one of which of greater throw than the rest, exposes the underlying limestone for a distance of about 12 miles in the middle of the block. The westerly dipping beds of the Kootenay form the western or Blairmore section mined at this latter place. East of this fold and overthrust, the coal-bearing beds are in synclinal form, though the edges of the basin are crumpled and faulted. The mines on the western limb of the syncline are at Frank and Hillcrest. The eastern limb is mined principally at Bellevue and Maple Leaf mines, while subsidiary basins to the east are mined at Passburg and Burmis.

The measures at Blairmore contain six seams, 10, 17, $3\frac{1}{2}$, $3\frac{1}{2}$, 17, and 6 feet in thickness respectively. At Bellevue, the section shows the following seams: 9, 17, $4\frac{1}{2}$, 15, 4, and $3\frac{1}{2}$ feet respectively.[1]

Livingstone Area.[2]

An important area now being prospected is crossed by the upper waters of Livingstone, Highwood, and Sheep rivers. It is generally wider than the southern basins and is divided at the north end by the upthrust of Mount Rae and by a less important anticline at the south. In the north on Sheep creek, the eastern branch of the exposed coal-bearing rocks is generally known as the P. Burns coal field. In this, the beds occupy a series of hills bordering the valley on the west. The beds dip away from the valley and are found at elevations as great as 2,000 feet above the stream. Sections published in the Can. Min. Journal, Dec. 15, 1912, give the following seams in descending order, 12 feet, 12 feet, $4\frac{1}{2}$ feet, 7 feet, 5 feet, and 14 feet. Ten or twelve seams have been exposed and traced for about 5 miles. The assay of the coal samples shows them to be very similar to samples from Canmore and Bankhead. The continuation of this area south joins the measures of the Blairmore-Frank field and in Cat mountain a section measured

[1] Geol. Surv., Can., Sum. Rep., 1911, pp. 192-200.
[2] Geol. Surv., Can., Sum. Rep., 1903, pp. 83-87.



Canmore coal mine, Alberta.

by Mr. Leach gives a possible 21 seams with 125 feet of coal in a thickness of 742 feet of measures.[1]

Coal has also been found on the small western limb west of Mount Rae, but this part of the field has not been carefully studied.

Moose Mountain Area.[2]

The Moose Mountain area south of Morley is in the form of an oval ring of Kootenay beds, surrounding an exposure of limestone which forms Moose mountain. The beds are much thinner than within the ranges, and show an evident tendency toward a loss of coal also. Two seams of coal have been opened on the east side of the mountain, of 7 and 8 feet in thickness, respectively. In each of the seams the character continues to be of good grade steam coal. The formation is cut by several streams, the valleys of which give access to the seams, and a great deal of this coal will be mined. Further prospecting in this area is reported, and a thick seam of 20 feet has been added to the above coal content.

Coal is also found in the Belly River beds which overlie the Kootenay and are exposed principally in the ridges to the east of Moose mountain.

Cascade Area.[3]

The Cascade area extends from south of Kananaskis river to within about 12 miles of the Saskatchewan. The coal measures are not continuous throughout this whole extent, but are interrupted by denudation and folds at the headwaters of the Cascade and Panther rivers. The beds to the south of Kananaskis river are divided in the centre by an anticline into two arms that narrow to two folds, which gradually pass upward, and are eroded away. North of this stream to the Bow valley, there is a thick block of measures dipping to the southwest, with a decided trough in the upper members of the series.

[1] Geol. Surv., Can., Sum. Rep., 1902, p. 171.

[2] Geol. Surv., Can., Sum. Rep., 1905, p. 67. Also Geol. Surv., Can., Report on Moose Mountain district, No. 968.

[3] Geol. Surv., Can., Part B, Annual Report, Vol. I (1885); Part D, Vol. II (1886); Sum. Rep., 1903, p. 88; Sum. Rep., 1904, p. 107; Cascade Coal Basin, Report No. 949.

At the northern end there are ten coal seams, each over 4 feet in thickness; the thickest of the upper ones reaching 15 feet. The total of these seams amounts to 68 feet.

From Wind mountain northward, the masses are planed off to the slope of the sides of the Bow valley, and at Canmore, mining is all below the level of the entrances, and the beds are found very much folded. North of the Bow, the coal in a large block east of Cascade mountain is being mined from the Cascade river at Bankhead.

No great area of coal land can be looked for between the Cascade and Panther rivers; though there are some beds not eroded from the hills in the centre of the valley. North of the Panther, several seams have been found. North of Red Deer river the section shows fifteen seams, between $4\frac{1}{2}$ and 11 feet in thickness, giving a total of 94 feet.

The coal found in the various parts of the area varies in composition from anthracite to bituminous. In the portion on the Cascade river and south to the Kananaskis, the lower seams may be said to be anthracite, or anthracitic; while in some places, the upper ones approach bituminous. In the northern part of the trough, north of the Red Deer, bituminous coals are found.

The coal seams found in the block north of the Kananaskis river have been prospected at several points. Near the Kananaskis, eleven seams with 57 feet of coal were found. Seven other seams a short distance north, have an aggregate of 41 feet of coal. Near the height of land to the Bow river, sixteen seams were discovered in a thickness of 1,000 feet of measures with an aggregate thickness of 86 feet of coal.[1]

At the old Marsh mine across from The Gap station, there are 12 seams of workable size with 77 feet of coal. Several are probably high in ash but there is a number of very fine clean seams. At Canmore, the seams worked are the Sedlock, Cary, and Nos. 6, 5, 4, 1, 3, and 2. These are all over 4 feet in thickness except No. 4 which is about 3 feet, and the coal is clean and bright.

At Anthracite, five seams in the lower part of the coal-bearing measures were mined in a synclinal fold. Two seams

[1] Geol. Surv., Can., Sum. Rep., 1908, p. 78.

of the higher series were tested to the west of the mine, but were thought to be too much cut up by slate partings to be profitably mined. At Bankhead, the thickness of the Kootenay formation approximates 2,800 feet. The coal-bearing beds seem confined to a thickness of about 1,100 feet. The seams cut in the mine tunnels are No. 5 with 6 feet of coal, No. 4 with 13 feet of coal in three benches, No. 3 with 19 feet of coal in two benches, No. 2 with 8 feet of coal, No. 1 with 7 feet of coal in thin bands, and No. 0 having 3 feet of coal.

Palliser Area.[1]

This area is crossed by the Panther river and is to the east of the northern extension of the Cascade basin from which it is separated by the Palliser range. This coal area is not of large extent although the depression between the limestone ranges is wide. The coal-bearing rocks are found only on the higher hills on the west side. They are near the fault line and dip beneath or abut against the limestone of the Palliser range. On the higher points of several hills in the valley, the lower parts of folds in the coal measures remain and coal seams are in evidence, but they are very much crushed and turn up at each side of the hill so that there is little coal in the exposure. Other seams, the continuation of these fragments, are found on the high ground near the fault line. Two coal seams of this class, 2 and 5 feet in thickness, are found on the south side and probably extend northwest the length of the basin.

Costigan Area.[2]

This area lies to the east of the Palliser, and is a better block of coal-bearing rocks. The seams are not numerous, however, and although four or five are known on the western edge of the basin, there appear to be only two workable seams with about 8 feet of coal outcropping at the east. The area is triangular in outline with the widest part along Panther river,

[1] Geol. Surv., Can., Cascade Coal Basin, Report No. 969, p. 34.
[2] Geol. Surv., Can., Cascade Coal Basin, Report No. 969, p. 35; Sum. Rep., 1907, pp. 38–40; Sum. Rep., 1904, pp. 116–121.

and extends north to the Red Deer river, on the northern side of which are two isolated areas of the coal-bearing rocks which may be considered as forming a part of the Costigan field. In the eastern area the lower part of the measures are found. In the northern, two seams of 3·8 feet and 3·3 feet in thickness were found. The measures here show a thinning to the east with also a lessening in thickness of coal. The number of seams is maintained, but all but two, which were workable, were mere ribbons.

Ram Creek Areas.[1]

Northeast of the extreme range of the Cascade coal basin, two areas are known to occur within the mountains, but as they have been only very slightly prospected, no estimate of their extent has been made.

Bighorn Basin.[2]

From the Saskatchewan north, an outer range of mountains reaches nearly to the Brazeau river. Behind this the coal measures are exposed on several streams, and are found to contain about 60 feet of workable coal.

The field consists of a large block of Lower Cretaceous measures uptilted on its eastern margin. The western border is a fault line along which the succeeding mountain ridge is pressed against uptilted beds of the Cretaceous basin. The coal-bearing rocks in the western part, where upturned, are in a very crushed condition, the mineable areas occurring along the eastern outcrop and in the cross valleys. The width of the basin from the eastern outcrop to the fault line, averages about 7 miles and at the centre of the syncline the coal horizon would be at depths below those possible for mining. The basin extends from the south side of the Saskatchewan valley, north to the north branch of the Brazeau river, a distance of 46 miles. Mr. G. S. Malloch, who mapped the southern part, has estimated that in a length of 30 miles there are 87 square miles of mineable

[1] Geol. Surv., Can., Sum. Rep., 1906, p. 69.
[2] Geol. Surv., Can., Sum. Rep., 1906, pp. 72-73; Sum. Rep., 1907, p. 33; Sum. Rep., 1908, p. 70; Memoir 9, Bighorn Coal Basin.

land with a coal reserve of 6,600,000,000 tons. The ascertained thickness of coal at several points is as follows:—

Bighorn river, south end of basin,	9	seams	with	52	ft.	of	coal
Wapiabi creek, north of above creek,	3	"	"	22	"	"	"
George creek, " " "	14	"	"	88	"	"	"
Blackstone creek, north of George creek	9	"	"	66	"	"	"
Chungo creek, north end of basin	6	"	"	26	"	"	"

A 20-foot seam has been opened on the Brazeau river where the measures cross the main stream.

The coal is bituminous and probably a great part coking.

Shunda Creek Area.[1]

West of the Brazeau hills which are portions of the serrated edge of an upthrusted limestone block crossing the Saskatchewan valley east of the Rocky mountains, the rocks of the Lower Cretaceous are exposed and have been prospected on the Saskatchewan valley, and on Shunda creek. The dip of the beds at the eastern edge is about 20 degrees, and in them occur four seams, 7 feet, 14 feet, 7 feet, and 4 feet in thickness, a total of 32 feet. This area is being mined at Shunda creek and is reached by railway directly up the Saskatchewan from Red Deer.

Nikanassin Basin.[2]

The measures of this basin are continuations of those of the Bighorn, and extend from the north branch of Brazeau river to the headwaters of McLeod river. A fault crosses the basin diagonally, running about north and south, and the trend of the northern part of the basin is deflected to nearly west. The measures have been prospected, and at the south end are known to contain three workable seams 5 feet, 3 feet 10 inches, and 7 feet thick, respectively. Near the centre, where the fault divides the field, five seams, aggregating 44 feet, are found. The western end is narrowed by a fault and the overthrust of the Palæozoic rocks to the west, the extreme end

[1] Geol. Surv., Can., Sum. Rep., 1911, p. 219.
[2] Geol. Surv., Can., Sum. Rep., 1909, pp. 140–146.

being crushed and broken. In the undisturbed part, seams of 21 feet, 7 feet 6 inches, and 4 feet 6 inches, are found and are being mined by the Mountain Park Coal Company, shipment being made eastward to the Grand Trunk Pacific railway at Bickerdike.

West Fork McLeod River Area.

An anticline of the Kootenay rocks outcrops southeast of Folding mountain on the west fork of McLeod river. This is possibly a continuation of the Folding Mountain anticline which crosses Brule lake on the Athabaska. On the eastern limb, where the dip is about 70 degrees, seams are reported having the following thickness: 2 to 3 feet, $8\frac{1}{2}$ feet, 4 feet, and 28 feet. On the western limb, the same seams occur, including a 50-foot seam which is probably a combination of the two lower ones of the eastern limb since they are there separated by only a few feet of shale.

Folding Mountain Area.

In Folding mountain, the Carboniferous and Devonian limestone form an anticline, and along its axis on the eastern limb, Lower Cretaceous rocks are exposed with nearly vertical coal seams showing thicknesses of 12 feet, 4 feet, 2 feet, and 6 feet of coal. A prospective coal mine is being located to be connected with the Grand Trunk Pacific railway by a short branch.

Brule Lake Area.

The anticline of Folding mountain pitches northwesterly and in front of Bulrush mountain, the outer edge of the Rockies, the lowest beds are of the Kootenay formation. In these beds, seams of 10 feet, 12 feet, and 5 feet have been found. No mining is being done but the newly constructed Canadian Northern railway crosses near the exposures.

The northern limit of the field is not ascertained, but, from the general topography, it is probable that it extends into the foothills as far as Smoky river, and is closely connected with another area within the mountains on Moose creek.

Roche Miette and Moose Creek Area.[1]

Within the first range of the Rockies, Cretaceous rocks are found in front of Roche Miette and in the valley of Moose creek. To the south, the beds rise somewhat and disappear. Northward they dip more gently and the area of coal bearing rocks appears to broaden. The field is divided by folds and at the south end by a fault. At the Athabaska, the measures are in two basins separated by an anticline. The eastern one narrows to the north and is probably mineable south of the Athabaska. The western one is either a monoclinal block or a broad syncline and several coal seams have been found. On the south side, at Pocahontas, a 10-foot seam dipping 52° is being mined by tunnel from the Athabaska valley. The entry and mine works are situated alongside the Grand Trunk Pacific railway tracks. On the north side of the valley, the Canadian Northern railway is located near the outcrops of several seams and a mine will probably be established on the seams of the western basin.

Northern Foothills Areas.

Several exposures of Kootenay rocks in the northern foothills have been found to contain coal seams of good quality. On Baptiste river, 6 or 7 seams ranging from 2 to 4 feet in thickness, are exposed in a synclinal trough. At another locality on the same watershed, a seam 16 feet thick has been discovered. On Muskeg river, just in front of the outer range of the mountains, coal-bearing beds occur in several anticlinal folds, and three seams are known, 11 feet 6 inches, 25 feet, and 7 feet thick, respectively.[2]

There is a large unexplored area northwards and in this there is, without doubt, further exposures of the Cretaceous coal-bearing beds.

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[1] Geol. Surv., Can., Sum. Rep., 1911, pp. 201-219.
[2] Geol. Surv., Can., Sum. Rep., 1909, p. 150.

BELLY RIVER FORMATION.[1]

General Statement.

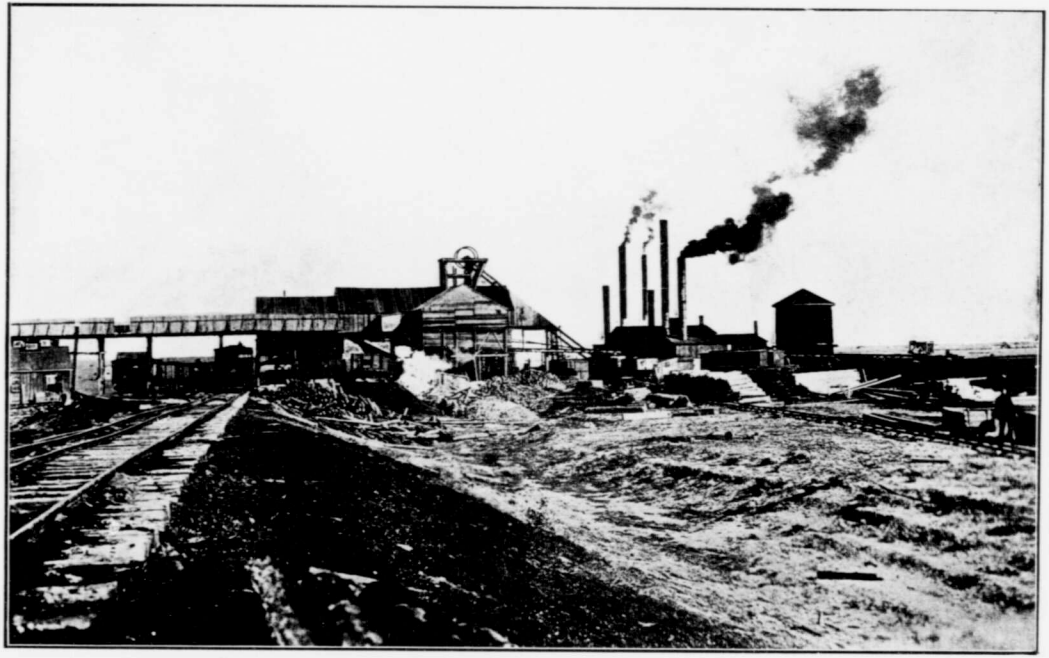
The second coal horizon lies above the Kootenay, and is separated from it by dark marine shales, which represent a period of depression in which this part of the continent was below sea-level. The rise which followed was arrested when the surface of this deposit reached sea-level, and vegetation again spread over the plain. The remains of this vegetation, compressed to coal, form an important coal field; for although the seams are not thick, the quality in the western portion of the exposed part is above the general average of lignite, and approaches true coal. In Saskatchewan this horizon has so far been found to contain very thin seams of inferior coal in the northern part of the area, and possibly a 4-foot seam in the southern border.

The general distribution of the rocks of this formation, as exposed at the surface, is shown on the accompanying map. The shape of the area there shown, is roughly that of a duck's head and neck, and over the part comprising the head, few exposures of coal are noted; but there are chances that settlers may find in their wells indications of coal. This portion owes its exposure to a slight anticline in the beds which brings them to the surface along a line that follows the direction of the roll. The other portion, the neck, is the great depression, too wide to be called a valley, into which the waters of the Belly, Bow, and Red Deer rivers, drain. The formation westward disappears beneath the trough which runs through Macleod and northward past Calgary, but reappears in several narrow bands in the foothills. To the northwest, in the Peace River country, two areas in which coal is found are regarded as of the same age as the Belly River formation.

The principal exposures of coal in this formation are on the Belly river near Lethbridge. The coal is of a better grade than in the beds above in the same vicinity.

South of Lethbridge the exposures include a few on the Milk River ridge, and one on St. Mary river about 6 miles

[1]Geol. Surv., Can., Report on the Region in the Vicinity of the Bow and Belly rivers, G. M. Dawson, Report of Progress, 1882–4, Part C.



No. 3 Pit, Lethbridge, 1898.

above its mouth, with a thickness of 3 feet 8 inches. At Lethbridge the main seam is 5 feet 6 inches, and is mined at several localities nearby. Other seams are noted below the mouth of Little Bow river—one of 3 feet 3 inches; and, 10 miles above Medicine Hat, a 4-foot seam is exposed in the river bank. At Stair two seams, 4 feet and 5 feet 3 inches, were mined for a time. The thicker one reappears below the bend, and has been traced as far as 25 miles below Medicine Hat.

Small seams have been found as far as the mouth of Red Deer river. On this stream three seams are known below the mouth of Bull Pound creek, having thicknesses of 1 foot, and which are evidently at about the same position in the series as the Lethbridge seams. On Bow river the Lethbridge seam is represented by a $4\frac{1}{2}$-foot seam, in township 17, range 17, west of the 4th meridian, and, according to Dawson's map, should pass the Canadian Pacific railway near Bantry station.

In the area between the two branches of the Saskatchewan, beside the coal seam which is at the top of the formation and, therefore, skirts the edge of the anticline of Belly River rocks, other seams in the formation are reported. Thus at Unity, Saskatchewan, a 4-foot seam has been found and its continuation possibly traced eastward to Tramping lake. At Salvador and vicinity, an 8-foot seam has been reported. At Brock, a similar thickness was found in a well, and at Kerrobert and other places in its vicinity, a small 2-foot seam has been found.

On the eastern slope of the depression, the Lethbridge seams should be represented by the coal found around the western base of the Cypress hills; the whole formation underlying the rocks forming that elevation. Near Irvine station a 4-foot seam has been found, which has unfortunately not been analysed; but it is probably lignite.

On the western side of the area, evidence of the presence of the formation beneath the shales of the Bearpaw or Pierre and even beneath the thicker sediments of the Bearpaw and Edmonton, is found in the logs of wells bored at certain points, such as at Tofield, where the coal seam, presumably at the top of the Belly river, was found at approximately 1,050 feet below the surface. At Edmonton, a seam of 6 feet at a depth of 1,400 feet, is taken to be the upper coal seam. In the Calgary well, several seams in what is thought to be the Belly River

rocks were reported at the following depths: a 5-foot seam at 2,562 feet, a 7-foot seam at 2,656 feet, and a 4-foot seam at 2,875 feet below surface.

Eastward, there is evidence that the formation may be coal-bearing beneath the rocks of southern Saskatchewan. This consists of the finding of two seams in a boring at Maple creek—a 4-foot seam at 197 feet and a 7-foot one at 292 feet from the surface.

The continuation of the beds eastward under the rocks of the plains can only be conjectured; but it is thought that they may thin out considerably and lose their coal-bearing character. Such occurrences as the drift coal below Prince Albert, and coal in the drift near Souris, Manitoba, are possibly evidences of this continuation.

Foothills Areas.

In the strip of the Belly River formation which runs through the foothills, large portions are not prospected, but for one area at least we have more details. This comprises the foothills south of the main line of the Canadian Pacific railway, as far as Highwood river. The coal seams exposed near the main line of the Canadian Pacific railway are thus described.[1]

"A good, clean-appearing seam of coal, 6 feet 6 inches wide, which has been worked to some extent by the Indians, outcrops on the Stoney reserve, about three and a half miles northeast of the eastern end of Chiniki lake. The coal dips to the west at about 30°, and has sandstone walls, with a few inches of mining next the footwall."

"A coal horizon was recognized on Jumpingpound creek about $1\frac{3}{4}$ miles east of the mouth of Sibbald creek, which may be the same as that northeast of Chiniki lake on the Stoney reserve. Only two very narrow seams, two to three inches thick, were noticed here; but coal was mined at this point a few years ago."

On the Elbow river two outcrops of a $2\frac{1}{2}$-foot seam are recorded on section 29, township 23, range 4, and section 33, township 22, range 5, west of 5th meridian. A similar seam

[1] Geol. Surv., Can., Moose Mountain District, Report No. 968, p. 14.

outcrops on Bragg creek in section 7, township 23, range 5, west of 5th.[1]

On the south branch of Sheep river, several exposures of coal occur. On the S.E. $\frac{1}{4}$ section 30, township 19, range 4, west of 5th meridian, is a seam over 7 feet in thickness of very good appearing coal. An average outcrop sample assayed by Dr. Hoffmann gives: moisture, 2·5 per cent, volatile combustible matter, 35·88 per cent, fixed carbon, 56·64 per cent, ash 4·98 per cent. There are also several narrower seams here of only a few inches in thickness. Farther down stream the Belly River rocks are crossed in several bands and exposures of several mineable seams occur. Two have been recorded on section 29, township 19, range 4, west of 5th meridian, as being from 5 to 6 feet in thickness, and five others from 2 to 4 feet.

Seams are reported south of this on Highwood river. Near Kananaskis station, the strata of the outer range of the Rockies overrides these beds, but it is not known whether or not they contain coal. Seams of lignitic coal in the mountains probably belong to this formation, since they appear to be higher beds than the coal-bearing ones just within the mountains farther down the stream, and identified as Kootenay.

Peace River Area.[2]

Two areas of these rocks are known in the Peace River country; one in Alberta reaching from Smoky river to the valley of Peace river, and extending northwesterly up that stream. Thin seams only are known.

Nearer the mountains, in the area belonging to British Columbia, better exposures have been found; and near the canyon of the Peace river, seams as thick as 9 feet are reported, though most of those from which analyses were obtainable are of scarcely workable dimensions.

Areal Extent.

The area over which the Belly River formation is exposed is not far short of 24,000 square miles. But this does not properly represent the coal-bearing area since a belt along the

[1] Ibid, p. 15.

[2] Geol. Surv., Can., Report of Progress, 1875–6, pp. 6, 53; Report of Progress, 1879–80, pp. 117, 119, 134–136 B; Report of Progress, 1882–1884, pp. 25–39 M.

outside of the exposure of the formation is generally considered to be the best point of the field. The outcropping area does not contain the highest seam since the beds are in anticlinal form and the uppermost seam has been eroded from the arch. The lower seam is probably present in a large part of the area.

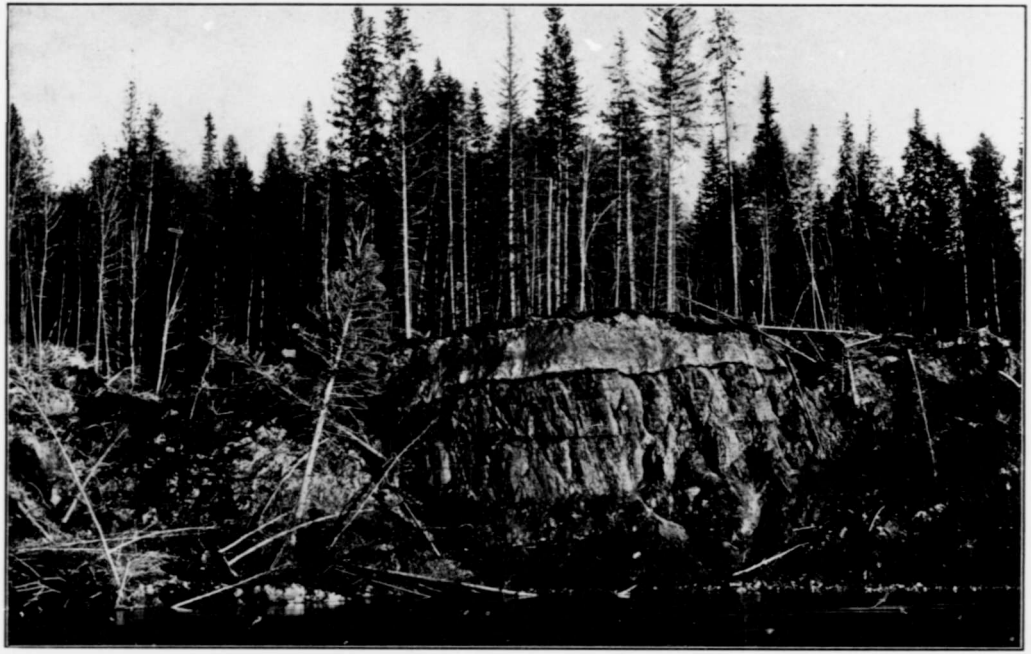
EDMONTON FORMATION.[1]

In Alberta, the shallow water deposits at the top of the marine Cretaceous although occasionally containing fresh water and land deposits, are generally of brackish water deposition. In these, numerous coal-seams mark land conditions with a flora very similar to the Tertiary flora of the Fort Union. The formation forms a wide trough filled along the centre by heavy sandstone and clay deposits of Tertiary age—the Paskapoo series. This trough widens towards the north, and also flattens, exposing a larger area of coal rocks than in the southern part. The productive area, therefore, forms a band surrounding the central sandstone portion, and dipping under it. On the western side the re-appearance from below is often accompanied by more or less disturbance, such as folds or waves, and faults. In this portion the effect of pressure has consolidated the coal to a greater extent, hence its character is improved.

The general description of the coal horizons of the Edmonton formation is summarized in Mr. J. B. Tyrrell's report on Northern Alberta, and is concise enough to be inserted in this sketch. On page 148 E of Vol. II, Annual Report of the Geological Survey of Canada, 1886, he says:—

"Of lignite coals, the only seam of any considerable thickness at present known in the Paskapoo series (just above this coal formation) outcrops on the North Saskatchewan, twelve miles above the mouth of Yapeoo or Buck creek, in township 49, range 7, west of the 5th principal meridian. The outcrop of the seam is very much obscured by land slides, but in one place a thickness of 15 feet of lignitic coal was measured, and the bottom of the seam was not seen. In another place, five miles distant, this seam was seen to have a thickness of 8 feet. Taking, therefore, $11\frac{1}{2}$ feet as the mean thickness of this seam

[1] Geol. Surv., Can., Report on Northern Alberta, Annual Report, 1886, Vol. II, Part E; and Report of Progress, 1873-4, pp. 17-65.



The Big coal seam, Saskatchewan river, near Goose encampment, 1886.

throughout the five miles down the river, and assuming that it extends for at least a mile over either side of the river valley, this area would be underlaid by 140,000,000 tons of lignitic coal. This appears to be the same coal horizon that is represented by a thin seam both on the upper part and near the mouth of Paskapoo or Blindman river, and at the trail crossing on Rosebud creek.

"At the top of the Edmonton series, between 400 and 500 feet below the last mentioned seam, there is a very persistent coal horizon that is seen cropping out on the North Saskatchewan with a thickness of 25 feet, on the Red Deer with a thickness of 10 feet, on Devils Pine creek with a thickness of $4\frac{1}{2}$ feet, on Threehills creek with a thickness of over 2 feet, and on Kneehills creek with a thickness of 4 feet. It is impossible, at present, to compute the enormous amount of lignite, but the following figures may be given as the quantity that may be relied on with considerable certainty as occurring in the immediate vicinity of some of the above outcrops.

"On the North Saskatchewan the seam was seen to extend in a straight line for three miles, retaining its thickness of 25 feet; and for several miles farther, large outcrops were seen that could not easily be measured. It was also, in one place, seen to extend a mile back from the river. If we take then a length of three miles of this seam, a width of a mile on each side of the valley, and a thickness of 20 feet, in order to allow for any local constrictions, this small area would be found to contain over 150,000,000 tons. On the Red Deer river the seam contains 12,500,000 tons per square mile; on Devils Pine creek, 5,500,000 tons per square mile; on Kneehills creek, 5,000,000 tons per square mile, and in the valley of this latter stream the seam was traced for from two to three miles down the creek. The line of outcrop of this seam has, therefore, been traced more or less continuously for 180 miles, and as will be seen by referring to the preceding pages, the lignite coals at the outcrops were of good quality.

"Throughout the Edmonton series there are various other coal seams of greater or less extent, many of which will be opened as the country becomes more fully developed; but the one that appears to be most persistent is found at a height of about 160 feet above the bottom of the series. At the mouth

of Rosebud creek this seam was found to have a thickness of 6 feet 10 inches, while on Battle river and Meeting creek, it has a thickness of 4 feet, representing 5,000,000 tons per square mile. This is essentially the same coal horizon that is again seen at Edmonton, on the North Saskatchewan, though it is hardly likely that the same seam is continuous throughout."

Few exposures of coal are known south of the Little Bow river. This district has not, however, been thoroughly examined, and the proximity of the Lethbridge mines—which produce a better grade than most of the coals of this formation—has discouraged prospecting.

On the Bow river, near Crowfoot crossing, two seams of 3 feet and 4½ feet respectively, seem to be worth working. A small mine has been opened on Crowfoot creek, by shaft, to a 9-foot seam.

On Red Deer river, seams of 5 feet and 6 feet are reported near the mouth of Rosebud river; and on a branch—Kneehills creek—a 4-foot seam is exposed.

Near the outlet from Buffalo lake two seams outcrop, the lower one occupying 18 feet of strata. The lower part (3 feet) is good lignite; in the upper portion about 3 feet are also of fair quality. The upper seam outcrops above Tail creek, and it has a great thickness of shaly material interstratified with the coal; but there is at the top a clear bench of 5 feet of coal.

On Battle river a few of the seams of this horizon are exposed. At the mouth of Meeting creek a seam of 4½ feet appears on the west bank, and others probably occur above this.

Under the town of Edmonton a couple of seams are being worked. These, though not above 6 feet in thickness, are of a good class for domestic use. The same seams underlie a large area in this vicinity, and are worked at many points. The principle mines are here, and at Morinville, north of Edmonton.

Skirting the edge of the sandstones which occupy the central part of the coal areas, it will be noticed that there is in the northern portion a persistent coal band. On the Red Deer river it appears to have only 5 feet of good coal in its upper part; but where this upper seam crosses the Saskatchewan above Edmonton it is a very valuable deposit, which is generally spoken of as the Big seam. This has 25 feet of coal, divided,

10 feet from the top, by 12 inches of shale. The continuation of this seam crosses the Pembina river, near the location adopted by the Grand Trunk Pacific, and will here certainly be mined. There are several heavy coal seams exposed, showing thicknesses of 26 feet, 10 feet, 13 feet, and a lower one of 6 feet.

Exploration of the northern continuation of the field has been limited; the outlining of the area being about all that has been attempted. Heavy beds of coal are found on the Athabaska above McLeod river, that may represent the horizon of the Big seam of the Saskatchewan. In the narrow band that intervenes between the sandstone of the centre of the trough and the disturbed area of the foothills, these coal beds undoubtedly reappear, and valuable coal beds have been found in them. There are probable repetitions of these beds all through the foothills as the latter, especially to the north, are formed of rocks which have been faulted along lines parallel to the mountain ranges, so that the beds are repeated many times. In the country along the route to the Yellowhead pass, coal-bearing rocks of this formation are found close to the mountains.

On the Pembina, Brazeau, and Saskatchewan, heavy lignite seams are known to outcrop. An analysis of the coal at Rocky Mountain House, near the confluence of the Clearwater and Saskatchewan, shows it to be of better grade than that farther down the river.

On Red Deer river a 10-foot seam, in range 7, west of the 5th meridian, is of this horizon, and west of Cochrane, at the Old Bow River mine, two seams which are reported as being $4\frac{1}{2}$ feet, and 7 feet 7 inches thick, respectively, are certainly of better grade than anything east of this point.

This band crosses Sheep river near the forks of the north and south branches, and lignites may there be looked for. On Highwood river a small seam is noted in range 2, which is probably at this horizon.

Behind the Porcupine hills the beds have not been traced, but nearing the Crowsnest river they are found again. A 7-foot seam near Cowley is probably in the Edmonton formation, as well as others on Pincher creek.

It is impossible to make any just estimate of the total amount of coal in this formation, as the area over which it is

spread is so extensive, and the thickness of the coal seams so uncertain, that an over-estimate would probably be the result.

In the estimate which was made for the "Coal Resources of the World," two calculations were made, one as conservative as possible, called the "Actual Reserve," and an additional amount, called "Probable Reserve," for which there was justification though probably not actual evidence of complete exploration. In the country south of Bow river an area of 3,600 square miles was credited with 5 feet of coal. Northward to Red Deer, this average was raised to 10 feet for an area of 2,400 square miles. For the upper seams, those covered by the Tertiary sandstones north of Red Deer, the estimate increased from 10 feet to a maximum of 25 feet, the thickness of the Big seam at the Saskatchewan, and for this coal, an area of 9,645 square miles was allowed. For the seams exposed at Edmonton and through the country to the south and east, the thickness was 8 feet from Bow river north to Beaver lake and for the Edmonton district, 15 feet. The total area thus estimated as containing coal of this age under "Actual Reserve" is 25,235 square miles and the tonnage 383,697,000,000 tons. To this is to be added areas not included in the above such as the foothills and parts north of the Athabaska, as well as seams at depths not at present considered economically mineable, which would add a "Probable Reserve" of 27,170 square miles and a tonnage of 417,261,000,000. This makes the estimated area 52,405 square miles and a total tonnage of 800,958,000,000 tons which is mostly sub-bituminous, grading to true coal in the west and to lignite in the east.

TERTIARY COALS.

Alberta: Paskapoo Formation.

Small seams of coal have been found in the Paskapoo sandstones of the central part of the Alberta syncline between Calgary and Edmonton. These are generally too thin to mine and are, therefore, not discussed in detail. The heaviest bed reported is on the Saskatchewan river[1] and others are found near Ponoka and Hobbema.[2]

[1] Geol. Surv., Can., Ann. Rep., Vol. II, p. 148 E.
[2] Geol. Surv., Can., The Edmonton Coal Field, Memoir 8, p. 15.

Cypress hills, from Big Plume creek, 1883.

Saskatchewan: Fort Union Formation.[1]

The Fort Union beds have been generally included under the term Laramie, but in Dakota the light coloured upper part is now correlated with the Fort Union, and is there as in Saskatchewan, lignite-bearing. The darker and yellower, lower beds are called the Lance formation, and have not been definitely recognized as such in Canada. The exposures containing coal are more numerous in southern Saskatchewan and Manitoba.

Besides the areas shown on the map, it may be noted that others in the north, especially on the summits of the more elevated portions, may be found by boring through the surface soil, and the possibilities of supplying the northern parts of the treeless country with serviceable fuel will be much increased. Reports of coal seams having been found in well borings near Prince Albert, have also been heard, but no definite information is at hand.

In the Cypress hills, and on the Coteau, these beds occur in the elevated portions of the country; but east of the Coteau there seems to be a basin in which they dip to the east, and so underlie the area traversed by the Souris river. The erosion of the valley of this stream in its great bend south into Dakota has separated the Souris area from its continuation in southern Manitoba, which is found again in Turtle mountain.

The area that is best known is the vicinity of Estevan on the Souris. Mining has been carried on here for several years. The seams are found exposed on the river banks, and located elsewhere by boring. An 8 foot seam is mined, though on some of the properties, near Bienfait, this is thickened up to 15 feet. Over a large part there are, per section, at least 7,000,000 tons of lignite available. Eight townships of this vicinity would, therefore, have a possible 2,000,000,000 tons. Coal will be found north to near Weyburn station, and west of this, outcrops have been recorded on the Souris, in township 3, range 15. Along the International Boundary, in about the same longitude, seams are exposed on Big Muddy creek, draining Willowbunch lake. These are of low grade lignite, and the seams are respect-

[1] Geol. Surv., Can., Ann. Report, Vol. I, 1885, part C; Ann. Report, Vol. XV, 1802-3, part F.

Cypress hills, from Big Plume creek, 1883.

ively 3 feet and 5 feet in thickness. At the crossing of Poplar river, in township 1, range 29, west of the 2nd meridian, there is an exposure of an 18-foot seam of lignite of about the same quality of coal as at Souris river.

Near the old Mounted Police post at Wood mountain, seams of 6 and 5 feet respectively have been opened, and have proved good domestic fuel. The same may be said of exposures at Willowbunch settlement. West of this the lignite beds underlie portions of the Swift Current plateau. In the Cypress hills, a 4-foot seam is recorded at the head of Lodgepole creek; so that, with the scattered areas in which coal seams have been found, exclusive of the Souris area, there are nearly 4,000 square miles on which there is good chance of finding coal. This area is capable of producing, for every foot thickness of coal worked, 3,720,000,000 tons, which, with the smallest workable thickness of 4 feet, means 13,000,000,000 tons.

Manitoba.[1]

The elevation called Turtle mountain, near the International Boundary in Manitoba, rises above a plain of denudation which is underlain by shales of the upper part of the Cretaceous. The hill is composed mostly of sandy beds belonging to the top of the formation, some of which are undoubtedly of the same age as the Edmonton series. Lignite seams have been found near the base where the surface deposit is easily penetrated. Higher up the slope there is a thicker mantle of drift, and owing to there being less settlement on the higher ground, this part remains unprospected, so that the known occurrences are as yet confined to the lower slopes. On the summit of the hill coal is reported in two places. The thickest seam so far found is between 6 and 8 feet, representing 5,000,000 to 7,000,000 tons per square mile.

The available area so far known does not exceed 48 square miles, but if only a workable seam of 4 feet were found, the available coal for this area would be 160,000,000 tons.

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[1] Geol. Surv., Can., Summary Report, 1902, p. 191.

LISTS OF OPERATING COAL MINES.

IN THE ROCKY MOUNTAINS AND FOOTHILLS, ON COAL SEAMS IN THE KOOTENAY FORMATION.

(*From list published by Mines Branch, Department of Mines.*)

Operator	Official number or name of mine	Location			
		Sec.	Tp.	R.	Mer.
J. H. Owen	295 Christie	NW. ¼, 11	5	1	5
Scott & McLean		20	5	1	5
A. Link	330	25	5	2	5
Moore & Dionne	253	36	5	2	5
Premier Coal Co., Ltd.	North Kootenay pass		5 and 6	4 and 5	5
Western Coal & Coke Co	199 Beaver	SE. ¼, 9	6	2	5
Carbon Hill Coal & Coke Co	293 South Fork		5 and 6	3	5
Head Syndicate	209	9 and 10	7	4	5
Leitch Collieries, Ltd.	126 Byron	15	7	3	5
Davenport Coal Co	153	14	7	3	5
Maple Leaf Coal Co	133	21	7	3	5
Hillcrest Collieries	40 Hillcrest	17 and 18	7	3	5
West Canadian Collieries	87 Bellevue	20	7	3	5
" " "	193 Blairmore	35	7	4	5
The Canadian Coal Consolidated	48 Gebo (Frank)	30 and 36	7	3	5
P. A. Paulson	261	9	7	4	5
North Kootenay Pass Coal Co	393	(?) 29	7	4	5
International Coal & Coke	88 Denison	8	8	4	5
McGillivray Creek Coal & Coke Co	204 Carbondale	17	8	4	5
West Canadian Collieries	Grassy Mt	25	8	4	5
Palmer Coal Co	394				
Western Can. Dev. Co., Ltd			13	3	5
P. Burns Coal Mines Ltd.		11, 19, 29	19	7	5
Rocky Mountain Collieries			22 and 23	9	5

LISTS OF OPERATING COAL MINES.—*Continued.*

IN THE ROCKY MOUNTAINS AND FOOTHILLS, ON COAL SEAMS IN THE KOOTENAY FORMATION.

—Continued.

Operator	Official number or name of mine	Location			
		Sec.	Tp.	R.	Mer.
Canmore Nav. Coal Co., Ltd.	.....	.....	23 and 24	9	5
Canmore Coal Co., Ltd.	2	29	24	10	5
Can. Pacific Ry.	80 Bankhead.....	19	26	11	5
Brazeau Collieries, Ltd.	256	.....	40	15	5
British Collieries, Ltd.	365	.....	43 and 44	20–21	5
North Brazeau Coal & Coke Co.	.....	.....	44 and 45	21–22	5
Mountain Park Coal Co. Ltd.	282	3 and 4	46	23	5
North Alberta Coal Syndicate	310	29	49	26	5
Jasper Park Collieries, Ltd.	280 Jasper.....	6	49	27	5

IN THE FOOTHILLS, ON COAL SEAMS PROBABLY IN UPPER CRETACEOUS MEASURES.

Operator	Official number or name of mine	Location			
		Sec.	Tp.	R.	Mer.
Thos. Nash	357 New Fancy.....	27	4	28	4
Dan Fitzpatrick	.....	35	4	28	4
Bullock Coal Mining Co.	292, 300.....	16	6	30	4
Pincher Creek Coal Mining Co.	145	17	6	30	4
Wm. McFarlane	222 Bedford.....	27	6	2	5
The Breckenridge and Lund Coal Co.	77	26	7	2	5
Galbraith Coal Co.	59	26	7	2	5
Mrs. Mary Wilson	190	36	8	2	5

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE BELLY RIVER FORMATION.

(Arrangement is from south to north.)

Operator	Official number or name of mine	Location				Remarks
		Sec.	Tp.	R.	Mer.	
J. H. Duncan	368	9	2	6	4	
Duncan Kippen	277	SW. ¼, 35	2	12	4	
Joe Oborn		31	2	15	4	Coal seam of Lethbridge horizon.
Erickson Bros	259	SW. ¼, 32	2	15	4	
S. Brockhouse	271	26	2	16	4	
Elizabeth Oborn		36	2	16	4	
H. B. Hughson	308	10	3	11	4	
Mitchell & Taite	381	16	3	12	4	
W. S. Abel	390	1	3	12	4	
Dan McKay	279	SE. ¼, 2	3	16	4	
Wm. Hartley	Emerald	SW. ¼, 34	5	15	4	Closed.
Wm. Roberts	353 Chin Coulee	36	6	12	4	
S. Smith	370	30	7	8	4	
T. R. Baker	56	7	7	21	4	Closed.
Geo. F. Russell	55	18	7	21	4	Coal seam of Lethbridge horizon. Closed
Jas. Perry & Son	Old Fort	2	7	22	4	
Bradshaw Mining Co	176	2	7	22	4	
J. H. Wall	Wall	2	7	22	4	
H. H. Foster	333	9	8	8	4	
H. Freidenberg	341	5	8	8	4	
H. S. Henry	345 Henry	6	8	10	4	
A. G. McGuire	343	E. ½, 25	8	22	4	Closed.
Jas. Ashcroft	54 Pioneer	35	8	22	4	Lethbridge Seam.
Plume Mining Co	200	2	9	5	4	May be seam in Tertiary outlier.
Wm. Conn		2	9	5	4	
Morgan Bros	323	14	9	11	4	
Galloway & MacKinnon	272	SE. ¼, 15	9	11	4	
Morning Star Coal Co	294 Star	LS. 16, 23, 25	9	13	4	
Jabez Rayner	180 Little Wonder	23	9	13	4	
Can. West Coal Co	105	31	9	16	4	Taber seam.
C.P. Ry	3 (No. 3)	NW. ¼, 6	9	21	4	Lethbridge seam.
"	3 (No. 6)	NE. ¼, 18	9	21	4	
New Barnes Co	203	31	9	21	4	
Royal Collieries	92 Barnes	NW. ¼, 31	9	21	4	
Lethbridge Coll., Ltd.	174	S. ½, 21	9	22	4	
A. E. Mitchell	331	SW. ¼, 3	10	11	4	
Burdett Coal Gas & Oil Co	206	SE. ¼, 23	10	12	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE BELLY RIVER FORMATION.—Continued.

Operator	Official number or name of mine	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Raisbeck Coll., Ltd.	154-157	9	10	13	4	
Sunlight Coal Co.	213	9	10	13	4	
Anglo-Canadian Coal Co.		15	10	13	4	
Reliance Coal Mining Co.		3 and 4	10	16	4	
Golden West Coal Mining Co.	201	18	10	16	4	Taber seam
Superior Coal Co.	202-229	18	10	16	4	
Eureka Coal Co., Ltd	82	8	10	16	4	
Domestic Coal Co.	106 Bullock	2	10	17	4	
C. P. Ry.	132	7	10	16	4	
Rock Springs Coal & Brick Co., Ltd.	170	3	10	17	4	
Alberta Consol. Coal Co., Ltd.	130 Scranton	3 and 4	10	17	4	Taber seam.
McLuckie & Ferguson	114 Independent	SE. ¼, 4	10	17	4	
Elcan Coal Co.	131 Hopeful	4	10	17	4	
Star Coal Co.		S. ½, 8	10	17	4	
Monarch Collieries	181	11	10	17	4	
Belly River Collieries	228	19	10	17	4	
Bathurst Mining Co., Ltd.	372	5	10	21	4	
Diamond Sunrise Coal Co.	276	9	10	21	4	
Diamond Coal Co., Ltd.	104	6	10	21	4	Lethbridge seam.
Adams Coal Mine Co. Ltd.	223	SE. ¼, 16	10	21	4	
Geo V. Heighes, Sr.	2541ronSprings	27	10	21	4	
Molloy Bros.	395	27	10	21	4	
Chinook Coal Co.	247	12	10	22	4	
Arblaster & Lloyd	270	5	11	11	4	
Moses Simpson	238	36	11	11	4	
D. H. Long	185 Domestic	36	11	11	4	
N. Walwark	186 Black Diamond	36	11	11	4	
J. H. Amos	356	NW. ¼, 28	12	7	4	
Ed. Lawrence		19	12	7	4	
Jules Lavenne	324	21	12	10	4	
O. J. Crouch	371 Spring Coulee	21	12	10	4	
A. A. Lindquist	205	22	12	10	4	
C. Raber	344	22	12	10	4	
W. H. Smart	358	22	12	10	4	
M. J. O'Neill	239	35	12	10	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE BELLY RIVER FORMATION.—Continued.

Operator	Official number or name of mine	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Ansley Coal Co., Ltd	37 Ansley	5	13	6	4	
Red Cliff Pressed Brick Co	165	5	13	6	4	
R. Black	334	29	13	10	4	
The Drowning Ford Coal Co	236	32	15	5	4	
E. Gardner	336	3 and 10	16	5	4	
Baker & Hoge	234	11	17	17	4	Lethbridge coal horizon.
Prairie Coal Co	226 Bow Centre	SE. ¼, 16	17	17	4	
T. W. Wise		27	19	10	4	
Bailey & Larson		33	19	10	4	
F. B. Park	257	NW. ¼, 7	23	14	4	

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.

(*Arrangement is from south to north.*)

Operator	Official number or name of colliery.	Location				Remarks
		Sec.	Tp.	R.	Mer.	
J. W. Seale	311 St. Marys	22	1	25	4	
Cardston Coal & Coke Co., Ltd	316	NW. ¼, 26	2	26	4	
Stavely Coal Mining Co	264	NE. ¼, 29	14	21	4	
W. J. Bell	143	NE. ¼, 25	14	22	4	
Durham Coll., Ltd	135 Stafford	36	14	22	4	
Wm. J. Sanderson	307 Carbon	8	15	21	4	
H. Theriault	136	8	15	21	4	
Du Rocherville Mining Co			15	3	5	
W. J. Greenaway	137 Snake valley	4	16	21	4	
Henderson Bros	134, 224 McCracken	29	16	21	4	
Wm. Ellis	296 Eckert & Ellis	5 and 8	16	23	4	
Ashmore & Carruthers	218 Blackfoot trail	8	16	23	4	Closed.
W. E. Watkins	198	4	16	23	4	
J. W. Brown	151	24	16	23	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.—Continued.

Operator	Official number or name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
E. Little	362	9	18	2	5	
L. F. Rathbun	363	8	18	2	5	
Dan Campbell	120	8	18	2	5	
Moore & Irwin	Ruby Coal mine	9	18	2	5	
C. E. McIntosh		16	18	2	5	
J. A. Grant	359	NW. ¼, 21	19	2	5	
A. D. McPherson	30 Black Diamond	8	20	2	5	
Blackfoot Indian Agency	72 Indian Reserve	6	21	20	4	
Jos. Woollings	361 Fish Creek	NW. ¼, 7	22	3	5	
F. B. Park	257	NW. ¼, 7	23	14	4	
Standard Coal & Devel. Co	360	NW. ¼, 2	25	22	4	
Rosebay Farming & Devel. Co	299	19	26	27	4	
Bonnie Brae Coal & Quarries Co., Ltd.	305	6	26	4	5	
The Mitford Coll. Co Ltd	160 Mitford	13	26	4	5	
Canada Cement Co		18	26	4	5	Closed.
J. A. Haeckel	309 Grey Eagle	21	28	14	4	
The Rose Deer Coal Mg. Co., Ltd.	347	20	28	19	4	
Rosedale Coal & Clay Products Co	346	NW. 28	28	19	4	
Albert Maynes			29	12	4	
Calgary Collieries Limited	321	19	29	12	4	
Wm. Oscar	262	19	29	12	4	Closed.
Geo. Sierk		16	29	13	4	
Midland Collieries	367	NE. ¼, 9	29	20	4	
Newcastle Coal Co	317	9	29	20	4	
Vulcan Coal Co	335	14	29	20	4	
Munson Coll., Ltd	335	28–29	29	20	4	
Drumheller Coal & Coke Co., Ltd	349	2	29	20	4	
Trumbles Coal Co	280	10	29	20	4	
J. Neisner & I. J. Daly	348 No. 1 and 383	23	29	20	4	
Chas. J. Hedstrom	189	7	29	22	4	
Knee Hill Coal Co	53	SW. ¼, 14	29	22	4	
Dodds, Currie & Hoding	115 Stopp	12	29	23	4	
Black Diamond Coal Co	187	13	29	23	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.—Continued.

Operator	Official number or name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Carbon Brick & Coal Co.	Carbon	19	29	23	4	
Knowlton Coll., Ltd.	219, 281	19-30	29	5	5	
Willoughby Greenhill	Minorn	12	29	6	5	
Hand Hill Coal Co.	354	21	30	17	4	
John Masciangio		28	30	17	4	
Wm. Goforsh		SW. ¼, 21	30	17	4	
F. Mason	380	SW. ¼, 28 NE. ¼, 13	30	17	4	
Duncan McKenzie	318 New Caledonia	29	30	22	4	
Knee Hill Coal Co.	194	NE. ¼, 4	31	22	4	
Chas. Catchpole	116	22	31	24	4	
Dick & Halbert	214	22	31	24	4	
Geo. Watson	142, 303 Creek	22	31	24	4	
Trentham	113 Abriel-Nichol	NE. ¼, 26	31	24	4	
Three Hills Coal & Devel. Co.	112	SW. ¼, 35	31	24	4	
Union Coal Co., Ltd.	384	36	31	24	4	
Jas. McGuire	385					
Trocher Coal Co.	322	SE. ¼, 34	32	23	4	
D. Halbert & Hedrich	315, 373	SE. ¼, 30	33	23	4	
Thos. A. Kane		1	34	14	4	
Helson & Johnson	376 U.F.A.	30	34	21	4	
W. M. Davis	326	34	34	21	4	Closed.
Geo. Nichol	327	SW. ¼, 5	34	22	4	
Anderson & Paul	337	10	34	22	4	
Geo. C. Tard	328 Black Deep	SW. ¼, 13	34	22	4	
G. W. Davidson	287	SW. ¼, 36	35	20	4	
Rol. T. Davidson	290	36	35	20	4	
Big Valley Coal Co.	364	1	36	20	4	
Jas. Tiar	Sweed mine	24	37	14	4	
Battle Axe Coal Mine	243	26	37	14	4	
The Interprovincial Coal Co.	304 Diamond	34	37	14	4	
McCormack Mining Co., Ltd.	246 McCormack	34	37	14	4	
The Castor Brick & Coal Co.	Frank	SE. ¼, 2	38	14	4	Closed.
Coalbeck Coal and Clay Products, Ltd	275 Coalbeck	3	38	14	4	
Jno. Heaney	329	NE. ¼, 4	38	14	4	
Excelsior Coal Co.	325	4	38	14	4	
Halkirk Collieries, Ltd	274	NE. ¼, 30	38	15	4	
T. D. Conger	255	SW. ¼, 17	38	23	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.—Continued.

Operator	Official number or name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Geo. Ralston		20	38	23	4	
Calgary Coll., Ltd.	314	SE. ¼, 29	38	23	4	
J. P. Dweak	166	34	38	23	4	
Arthur Moorhouse		11	38	24	4	
C. Hilker	212	8	39	15	4	
Alberta & British Columbia Coal Co.		SE. ¼, 8	39	15	4	
Davis & Greene	273 Affrida	S. ½ LS., 12–18	39	15	4	
C. R. James		N. ½, 18	39	15	4	
Karans & Stiebritz	240	NW. ¼, 32	39	15	4	
Cable Bros. & Williams	289	28	39	16	4	
Alf. Anderson		NW. 22	39	16	4	
H. Baines	312, 288	NW. ¼, 28	39	16	4	
P. J. & Jos. Wagner	291	SW. 28	39	16	4	
Beaver Dam Coal Mines	168	NE. ¼, 11	39	22	4	
Ben Nevis Colliery	167	11	39	22	4	
Martin Coal Mines		SE. 6	40	15	4	
Nor. T. Rider	320	NW. ¼, 31	40	15	4	Closed.
Rocky Mountain Coal Co.	388	Saunders Creek	40	12	5	
L. Martin		NW. ¼, 28	40	15	4	
W. Robinson		SE. 32	40	15	4	
Bish Bros.	245	NW. ¼, 36	40	16	4	
Glen Hayes Mg. & Townsite Co.		13–24	40	18	4	
Coalfax Coal Mining Co.	248 Le Gear	1	41	16	4	
J. E. Pleming		20	41	17	4	
W. R. Gilmore		30	41	17	4	
J. M. Schares	249	S. ¼, 16	42	17	4	
Julius Wilkinson	251	28	42	17	4	
C. C. Potter	242	15	44	19	4	
Battle River Coll.	302	7	46	18	4	
Bawlf Collieries, Ltd.	232	SW. ¼, 10	46	18	4	
The Stoney Creek Collieries, Ltd.	183 and 244	28 and 33	46	20	4	
Pacific Pass Coal Fields, Ltd		3	47	19	5	
Schulstad & Wilson		28	47	20	4	
Round Hill Coll.	250	29–30	48	18	4	
The Spicer Coal Co., Ltd.	241 Rakowski	SW. ¼, 18	48	19	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.—Continued.

Operator	Official number or name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Schmidt & Wilson	374	N. ½, 12	48	20	4	
Yellowhead Pass Coal & Coke Co., Ltd	220	6	48	21	5	
McLeod Coll., Ltd	339	33	48	21	5	
J. J. McDevitt	149 Pioneer	24	49	19	4	
Tofield Coal Co., Ltd	150 and 252	23-26	50	19	4	
The Debell Coal Co	340	SW. ¼, 35	50	19	4	
Zucht & Pachel		6	51	25	4	
Wetaskiwin Coal Co		NE. ¼, 20	51	25	4	
White Star Coal Co	29	25	51	25	4	
Lake View Coal Co	319	29	52	4	5	
Twin City Coal Co., Ltd	177	River Lot 19	52	24	4	
	46 Bush	" 42	53	23	4	Probably closed.
Humberstone Coal Co	43	NW. ¼, 7	53	23	4	
Wm. Daly	8	7	53	23	4	
The Keith & Fulton Coal Co	69	7	53	23	4	
Byers Bros	90 Black Rock	NW. ¼, 8	53	23	4	
Ph. Ottewell	91	SW. ¼, 17	53	23	4	
The Clover Bar Coal Co., Ltd	9	18	53	23	4	
The Western Coal Co. Ltd	148 Stewart	River Lot 31	53	24	4	
The Ritchie Coal Co	147	" 20	53	24	4	Closed.
The Dawson Coal Co	155	" 25	53	24	4	
Edmonton Standard Coal Co	49 City mine	" 26	53	24	4	
Connor Coal Mining Co	260	SW. ¼, 14	53	4	5	
Security Coal Mines Co., Ltd	263	NE. ¼, 16	53	4	5	
Cardiff Collieries, Ltd		10	53	5	5	
Gainford Coal Co., Ltd	352 Cameron	14	53	6	5	
Pembina Coal Co., Ltd	227	NE., 30	53	7	5	
St. Albert Collieries	267		53	25	4	
Murdock Sutherland	110	4	54	24	4	
Ruperts Land Co	Catherine	11	54	24	4	
The Great West Coal Co., Ltd	283	5, 6, 7, and 8	55	23	4	
Nash & Williams	178 Kelly		55	24	4	
Frank Smith	De Beers	SE. ¼, 8	55	24	4	

LISTS OF OPERATING COAL MINES.—*Continued.*

IN ALBERTA, ON COAL SEAMS IN THE EDMONTON FORMATION.—Continued.

Operator	Official number or name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Stuart & Campbell	28	8	55	24	4	Closed.
Duthie, Wilcox & Gwillim	397					
The Bell Coal Mine	101 Bell	NW. ¼, 9	55	24	4	
Cameron Bros	386					
E. J. Auten		SE. ¼, 18	55	24	4	Closed.
Laughlan & Spedding	75	16	55	25	4	Closed.
Alberta Coal Mining Co	129	NE. ¼, 23	55	25	4	
Capital Coal Co	237 Gervais	SW. ¼, 24	55	25	4	
Cardiff Coll., Ltd	32	13-24-25	55	25	4	
Riviere Qui Barre Coal Co	221	30	55	26	4	
W. Fortin	351	25	57	25	4	
Ward & Payment		26	57	25	4	
Peace River Coll	392 on Athabaska		60	14	5	

IN SASKATCHEWAN.

Operator	Official number and name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
Excelsior Coal Mining Co., Ltd		W. ½, 30	1	5	2	
Samuel Frayn		22	1	6	2	
Pinto Coal & Brick Co	Pinto mines	25	1	6	2	
C. O. Holstein	Munro mine	28	1	6	2	
The Kelly Mining Co	Kelly mine	29	1	6	2	
J. F. Bulmer	Riverside mine	34	1	6	2	
Short Creek Coal Mining Co		NE. ¼, 24	1	7	2	
Niels Anderson		28	1	8	2	
Jas. Forbes		31-32	1	28	2	
Marsh & MacQuarrie	Pure Lignite mine					
Western Dom. Coll., Ltd	Bienfait	3	2	6	2	
The Man. & Sask. Coal Co., Ltd	Hudson Bay mine	10	2	6	2	

LISTS OF OPERATING COAL MINES.—*Continued.*

SASKATCHEWAN.—Continued.

Operator	Official number and name of colliery	Location				Remarks
		Sec.	Tp.	R.	Mer.	
The Bienfait Commercial Co.		19	2	6	2	
Maple Leaf Mines, Ltd.		4	2	7	2	
Souris Collieries Co.	Souris	SW. ¼, 4	2	7	2	
H. Nicholson	Nicholson mine	2	2	8	2	
Jno. R. Palmer	Palmer mine	4	2	8	2	
Great West Coal Co.	Big Chunk and New Record	LS. 11, 10	2	8	2	
Thos. Hite		10	2	8	2	
George Pawson	Pawson mine	10	2	8	2	
Geo. Parkinson	Johnson mine	11	2	8	2	
Dugald Arbuckle		11	2	8	2	
Estevan Coal & Brick Co.		14	2	8	2	
Rooks & McNeil		14	2	8	2	
Thos. D. Munro	Munro mine	14	2	8	2	
Wm. H. Rollinson	Gleason mine	16	2	8	2	
Wm. Lloyd	West mine	18	2	8	2	
Olaf Person		NE. 30	2	25	2	
Reg. T. Eidsness	Diamond mine	LS. 3–11	3	19	2	
Brongard & Johnson	Crescent mine	LS. 6–11	3	19	2	
Mr. Waldron		32	3	26	2	
W. Dee	Dee mine	LS. 6–22	4	16	2	
W. J. Ewing	Swing mine	22	4	16	2	
Mrs. L. Pierce		22	4	16	2	
Jas. Start		7	4	26	2	
C. C. King		8	4	26	2	
Louis Roy		23	4	27	2	Closed.
Jos. Boucher		LS. 2–24	5	28	2	Closed.
E. Pierce		16	5	6	2	
Wm. Carson		16	7	19	3	
M. K. Nordgulin & Kunston		24	7	29	2	
Albert Caillet		27	7	27	2	
Frank Wilhelm		28	7	27	2	
Six Mile Coal Co.		LS. 15 of 18	7	28	3	
Wickham & Lewis		3	8	21	3	
Consumers Coal Co., Ltd.		36	10	28	2	
South Sask. Devel. Co.		13–24	12	24	2	
Florence E. Sharon		24	12	24	2	
A. C. Tangedalbel & Schaefer		20	30	20	2	

ANALYSES OF COALS.

Reference numbers in tables are for the following publications:—

1. Report on the efficiency of various coals used by the United States Ships, 1893–95. Bureau of Equipment, Washington, 1895.
2. Report on the efficiency of various coals used by the United States Ships, 1895–96. Bureau of Efficiency, Washington, 1897.
3. Report on the efficiency of various coals used by United States Ships, 1896–98. Bureau of Equipment, Washington, 1899.
4. Operations of the coal-testing plant at St. Louis, 1904. United States Geological Survey, Professional Papers, No. 48.
5. Preliminary report on the fuel testing plant, St. Louis, 1905. Bull. United States Geological Survey, No. 290.
6. Report of Minister of Mines, B.C., 1902.
7. Reports Geological Survey, Canada, to Vol. XVI.
8. Report of the Department of the Interior, Canada, 1881, p. 52.
9. Second Report of Progress in the laboratory of the Second Geological Survey of Pennsylvania, 1876–78, by A. S. McCreath.
10. Report Michigan Geological Survey, 1905.
11. Summary Report, Geological Survey, Canada, 1906.
12. Report of the Section of Chemistry and Mineralogy, G.S.C., No. 958.
13. Cascade Coal Basin, by D. B. Dowling, No. 949.
14. Unpublished analyses by F. G. Wait, Geological Survey, Canada.
15. Summary Report, Geological Survey, Canada, 1907.
16. Report on the 49th Parallel, by G. M. Dawson.
17. Moose Mountain district, Alberta, by D. D. Cairnes, No. 968.

ANALYSES OF COALS.—*Continued.*

18. Report of Minister of Mines, B.C., 1901, p. 1185.
19. Report of Minister of Mines, B.C., 1906, p. 119.
20. Report Michigan Geological Survey, 1904, p. 127.
21. Geological Survey of Pennsylvania, 1895.
22. Geological Survey of Pennsylvania, 1886, Pt. 1, p. 267.
23. Geological Survey of Pennsylvania, Report of Laboratory, 1876–78.
24. Minerals of Nova Scotia, by E. Gilpin, Halifax, 1901.

Analyses of Canadian coals are generally made from small samples, which are, probably, more or less air-dried. The United States coals in the first five references are from large lots fresh from the mine. The air drying loss is, therefore, given along with the analysis of the air dried sample.

KOOTENAY COALS, ELK RIVER, B.C.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Headwaters Elk river—									
Seam at height of land, 15 ft.	13′–0″	3·44	9·10	21·00	57·00	12·90	.....	.....	14
Seam at height of land, south side, small seam	.....	2·70	3·36	45·27	47·70	3·67	.....	.....	14
Seam opposite Elk lake in centre of valley	6′–0″	3·59	4·90	30·06	56·60	8·44	.....	.....	14
Prospect tunnel on Aldridge creek	7′–0″	4·45	1·60	32·47	63·44	2·49	.....	.....	14
Seam on Elk river	15′–0″	7·27	.....	21·76	68·20	10·04	.....	.....	7
Michel—									
Mine No. 3, highest seam worked	15′–0″ to 30′–0″	7·28	1·00	20·57	72·00	6·15	0·28	14656	6
Mine No. 4, 80 ft. below highest seam	10′–0″ to 30′–0″	7·60	1·00	18·93	70·13	9·50	0·44	13850	6
Fernie—									
Mines Nos. 1 and 2, Coal creek	8′–0″ and 6′–0″	7·01	0·84	22·38	73·17	3·15	0·46	14935	6
No. 1 mine, seam 9 ft. below 8 ft. seam	9′–0″	7·15	0·92	18·85	64·42	15·65	0·16	13757	6
No. 3 mine, Coal creek, upper seam of No. 2 mine	6′–0″	7·34	0·92	20·63	72·05	6·00	0·40	14284	6
No. 4 mine, Coal creek, 750 ft. below No. 1	22′–0″	8·92	0·96	13·46	61·92	23·50	0·16	12114	6
Morrissey—									
Mine No. 1, steam coal	18′–0″	6·83	0·90	22·19	70·99	5·60	0·32	14346	6
Mine No. 2, steam coal	18′–0″	11·52	0·82	11·73	71·50	15·75	0·20	12858	6
Marten creek—									
Jubilee seam, 2nd crossing	30′–0″	4·59	1·89	30·41	63·33	4·37	0·48	14447	7
Peter seam, 2nd crossing	14′–0″	4·26	1·79	33·04	61·55	3·62	0·51	14490	7
Small seam, 2nd crossing	2′–0″	3·67	2·12	26·92	43·48	27·48	.....	.....	.....
Cannel coal, "Birdseye splint"	.....	.....	2·10	57·71	30·33	9·86	.....	.....	.....

KOOTENAY COALS, COLEMAN AREA, ALBERTA.

Localities	Thickness of seam	Split vol. ratio	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Steam: No. 2 seam, Coleman. Average of 2 analyses	16′–0″	5·60	0·45	25·42	61·10	13·03	.....	.....	G. H. Dickson.
Coking: No. 4 seam, Coleman. Average of 2 analyses	6′–0″	8·51	0·74	16·61	68·65	13·50	.....	.....	"
Half mile north of Coleman. Middle seam	2′–10″	4·50	1·82	24·55	51·22	22·41	.....	.....	7

KOOTENAY COALS, BLAIRMORE-FRANK AREA, ALBERTA.

Coal from near Blairmore	.....	11·53	1·22	11·70	75·67	11·41	.....	.....	7
Two miles from Frank	.....	4·83	0·71	29·78	61·49	8·02	.....	.....	14
South fork Oldman river, 4 miles above south branch	9′–9″	5·10	1·93	23·23	57·50	17·34	.....	.....	7

KOOTENAY COALS, LIVINGSTONE AREA, ALBERTA

Livingstone river, sec. 35, tp. 10, R. 3, west of 5th	30′–0″	4·51	1·03	32·20	61·28	5·49	.....	.....	12
" " "	5′–0″	5·69	1·75	19·99	58·40	19·86	.....	10947	7
Livingstone river, northwest branch	8′–0″	5·82	1·24	24·62	66·61	7·53	.....	.....	7
Sheep creek, south branch near Burns location, Sec. 11, tp. 17, R. 7, west of 5th	9′–6″	12·03	1·30	11·14	77·13	10·43	.....	.....	7
	9′–6″	11·61	0·52	13·19	76·00	10·29	.....	.....	14
Sheep creek, Burns location	8′–8″	12·37	0·74	11·51	74·71	13·04	.....	.....	14
North end of area near Tombstone mountain, Kananaskis river	.....	9·55	0·87	13·66	66·72	18·75	.....	.....	12

KOOTENAY COALS, MOOSE MOUNTAIN AREA, ALBERTA.

Localities	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Forgetmenot ridge, sec. 25, tp. 21, R. 7, west of 5th	5′–4″	4·40	6·68	20·68	64·71	7·93	.....	.....	17
Sheep creek, secs. 19 and 30, tp. 19, R. 5, west of 5th	.....	9·00	0·53	14·99	64·55	19·93	.....	.....	17
Sheep creek, sec. 36, tp. 19, R. 5, west of 5th	3′–0″	7·78	0·69	19·98	73·12	6·21	.....	.....	17
Coxcomb mountain, sec. 34, tp. 23, R. 7, west of 5th	3′–0″	10·16	1·64	14·26	82·01	2·09	.....	.....	17
Near Thorne mine, Moose mountain, Top seam	1′–6″	7·47	1·86	19·23	76·07	2·84	.....	.....	17
Near Thorne mine, Head of Bragg creek	7′–6″	9·64	1·17	13·54	69·77	15·52	.....	.....	17
Moose mountain, sec. 8, tp. 23, R. 6, west of 5th	6′–10″	7·00	2·74	18·62	75·52	3·12	.....	.....	17

KOOTENAY COALS, CASCADE AREA, ALBERTA

Marsh mine, opposite Gap siding	12′–0″	13·73	0·70	11·03	79·78	8·49	.....	.....	7
Marsh mine, lower seam	10′–0″	8·57	1·02	7·24	36·16	55·58	.....	.....	7
Gully near Marsh mine	15′–6″	8·44	3·50	13·10	77·90	5·50	.....	.....	13
"	4′–0″	9·93	2·60	12·40	81·20	3·80	.....	.....	13
"	4′–6″	11·62	1·00	12·50	78·00	8·50	.....	.....	13
"	4′–0″	10·21	2·50	11·50	78·50	7·50	.....	.....	13
"	4′–6″	12·17	2·50	9·50	83·50	4·50	.....	.....	.....
Canmore: Sedlock prospect	5′–6″	12·22	0·92	12·78	82·99	2·55	0·75	.....	13
"	5′–6″	12·64	0·04	14·03	82·11	2·82	1·07	.....	13
Canmore: seam at river near Cary seam	.....	11·47	1·60	12·23	82·32	3·85	.....	.....	7

KOOTENAY COALS, CASCADE AREA, ALBERTA.

Localities	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Canmore mine: Commercial samples	.....	12·92	1·97	9·93	84·61	3·29	0·20	.....	2
" " "	.....	15·33	1·10	9·716	86·367	2·676	0·144	.....	1
" Seam No. 6	4′–6″	10·48	0·49	16·04	81·14	2·33	.....	.....	13
" " No. 5	5′–3″	10·17	1·10	14·66	78·38	5·20	0·66	.....	13
" " No. 5	5′–3″	10·51	2·00	12·90	82·40	2·70	.....	.....	13
" " No. 4, outcrop	3′–1″	11·00	1·25	13·52	81·30	3·47	0·46	.....	13
" " No. 4, in mine	3′–1″	10·34	0·72	15·73	80·90	2·65	.....	.....	12
" " No. 1	5′–8″	11·19	0·43	15·10	81·74	2·73	.....	.....	13
" " No. 2	4′–0″	11·82	.....	14·70	79·00	6·30	.....	.....	13
" " No. 3	5′–0″	15·30	.....	11·80	84·40	3·80	.....	.....	13
Cascade river, opposite Bankhead, lower	1′–8″	8·23	2·07	15·84	74·35	7·74	.....	.....	7
Cascade river, exposure opposite Bankhead, upper	4′–0″	14·15	0·71	10·79	80·93	7·57	.....	14134	7
Anthracite, probably Seam No. 3	3′–10″	16·35	1·04	9·15	87·18	2·63	.....	.....	7
Anthracite mine: Seam A	8′–7″	24·17	.....	7·65	88·72	3·63	.....	.....	13
Bankhead: Seam No. 2, B. level	8′–0″	15·71	0·43	10·65	85·02	3·90	.....	.....	12
Snow creek, branch of Panther river	5′–0″	7·90	0·72	21·28	75·80	2·20	.....	.....	
Seams near Prow mountain	.....	5·84	2·14	23·83	69·67	4·37	.....	.....	15
North side Red Deer river, near Prow mountain	.....	5·74	1·58	25·08	66·60	4·74	.....	.....	15
South side Red Deer river, near Prow mountain	.....	4·43	2·90	29·26	62·95	4·89	.....	.....	7
Between Red Deer and Clearwater seams in measured section:—									
Seam No. 3	8′–0″	7·42	1·55	18·75	71·20	8·50	.....	.....	15
Seam No. 5	2′–6″	6·77	2·05	20·75	73·12	4·08	.....	.....	15
Seam No. 10	11′–0″	7·63	1·20	19·61	74·17	5·02	.....	.....	15

KOOTENAY COALS, PALLISER AREA, ALBERTA.

Localities	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
South of Panther river: Upper seams.	5′–0″	14·28	0·93	10·58	83·55	4·94	.....	.....	13
" " Lower seam..	2′–0″	13·11	1·13	11·59	84·94	2·34	.....	.....	13

KOOTENAY COALS, COSTIGAN AREA, ALBERTA.

South Branch, Panther river.....	4′–0″	11·85	1·52	11·65	81·16	5·67	.....	.....	7
Panther river, eastern outcrop, Costigan seam	4′–4″	11·00	1·14	13·63	80·64	4·59	.....	.....	7
Panther river, western outcrop, Costigan seam.....	4′–9″	10·00	0·69	15·75	77·15	6·41	.....	.....	.....
North edge of area south of Red Deer river.....	4′–2″	10·48	1·80	13·11	81·01	4·08	.....	.....	15
North edge of area south of Red Deer river.....	5′–4″	9·05	2·14	15·01	79·73	3·12	.....	.....	15
Western upturn, Panther river, 164 feet below Costigan seam.....	3′–9″	9·73	0·79	15·66	76·05	7·50	.....	.....	7
270 feet below Costigan seam, north side.....	3′–6″	9·92	0·61	16·49	79·56	3·34	.....	.....	7
270 feet below Costigan seam, south side.....	3′–8″	9·35	1·14	16·27	78·61	3·98	.....	.....	15
Lowest seam, near fault line.....	11′–0″	9·88	1·87	13·74	79·55	4·84	.....	.....	7
Scalp Creek area, west of trail north of Red Deer.....	3′–3″	8·54	1·90	16·10	76·89	5·11	.....	.....	15

KOOTENAY COALS, BIGHORN AREA, ALBERTA.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Cohn creek, North Saskatchewan river—									
Seam No. 1	2′–2″	4·06	5·80	25·50	62·60	6·10	.....	.....	14
Seam No. 2	1′–10″	4·89	3·74	25·50	67·00	3·76	.....	.....	14
Seam No. 3, average of 2 analyses.	5′–6″	5·76	1·38	25·59	68·92	4·10	.....	14041	14
Seam No. 4, average of 2 analyses.	7′–6″	6·38	0·79	23·58	68·51	7·50	0·65	13789	14
Bighorn river—									
Seam No. 2, average of 3 analyses.	4′–6″	6·35	0·99	23·17	68·24	7·60	0·57	13448	14
Seam No. 3, average of 3 analyses.	6′–0″	6·98	0·87	21·46	70·38	7·26	0·66	13712	14
South Brazeau river, top seam—	1′–7″	4·61	2·00	28·55	60·75	8·70	.....	.....	14
Big seam, average of 3	14′–5″	4·99	1·85	26·99	62·78	8·37	0·45	.....	11 and 14
Kidd seam, average of 3	8′–0″	5·24	2·04	24·38	62·48	11·09	0·56	.....	14
South Brazeau river, average of 3 analyses—									
Seam No. 8	11′–9″	6·50	1·05	22·58	68·99	7·37	0·47	14146	14
Seam No. 1	4′–10″	5·99	1·12	23·74	65·93	9·19	0·81	13200	14
Seam No. 2	3′–11″	5·78	1·28	24·59	66·26	7·87	0·60	13510	14
Seam No. 4	5′–10″	6·49	1·18	23·18	71·08	4·56	0·52	14068	14
Seam No. 5	5′–8″	5·25	3·07	24·07	67·33	5·52	0·59	12890	14
Seam No. 6	8′–5″	4·78	3·93	21·14	61·96	12·92	0·43	9976	14

BELLY RIVER COALS, AREAS IN FOOTHILLS, ALBERTA.

Oyster creek, in mountains head of Livingstone river	Small.	2·77	4·03	31·82	39·46	24·69	.....	.....	7
Mill and Pincher creeks: sec. 10, tp. 5, R. 1, west of 5th	8′–0″	5·81	1·99	20·88	61·87	15·26	.....	.....	7

BELLY RIVER COALS, AREAS IN FOOTHILLS, ALBERTA.

Localities.	Thickness of seam	Split vol. ratio	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Mill creek, 4 miles above mill	8′–0″	4·53	1·63	28·43	57·57	12·37	.....	11887	7
St. Mary river near Boundary	1′–6″	4·37	5·05	25·30	64·65	5·00	.....	.....	16
Sheep creek, South branch: sec. 20, tp. 19, R. 4, west of 5th	5′–0″	3·78	2·16	34·65	56·42	6·77	.....	.....	17
Sheep creek, South branch: sec. 30, tp. 19, R. 4, west of 5th	7′–0″	3·65	2·50	35·88	56·64	4·98	.....	.....	17
Bragg creek: sec. 7, tp. 23, R. 5, west of 5th	2′–6″	2·19	9·31	35·59	41·72	13·38	.....	.....	17
Stoney Reserve, Morley	6′–0″	3·16	1·26	41·30	48·60	8·84	.....	.....	7

BELLY RIVER COALS, LETHBRIDGE-MEDICINE HAT AREA, ALBERTA.

North side Milk River ridge	1′–6″	2·14	9·84	31·92	39·41	18·83	.....	8964	7
North side Milk River ridge, 1½ miles east Fossil coulee	1′–6″	2·81	5·58	37·77	49·85	6·80	.....	.....	7
St. Mary river, 7 miles from Belly river	3′–8″	2·71	7·02	36·47	50·22	6·29	.....	11331	7
Lethbridge. Analysis supplied by T. Denis	5′–6″	3·12	4·37	34·61	50·43	9·89	.....	.....	.....
Coal Banks, Sherans mine	5′–6″	3·27	6·52	31·03	56·54	5·91	.....	.....	.....
Coal Banks, Sherans mine, outcrop	5′–6″	2·62	6·50	38·04	47·91	7·55	.....	11129	.....
Taber coal mines: upper bench	0′–5″	2·38	11·36	26·64	45·60	16·40	.....	.....	.....
" " lower bench	3′–3″	2·62	10·82	27·84	50·93	10·41	.....	.....	.....
" " average 2 analyses	3′–3″	2·46	7·21	39·18	46·36	7·22	.....	.....	14
McPhee mine: sec. 1, tp. 10, R. 17, W. of 4th	2′–7″	2·53	11·35	29·98	51·63	7·04	.....	.....	.....
Belly river, 5 miles below Little Bow river	3′–3″	2·49	9·18	34·97	49·00	6·85	.....	10478	7

BELLY RIVER COALS, LETHBRIDGE-MEDICINE HAT AREA, ALBERTA.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Grassy island, Bow river	4′–6″	2·19	11·90	35·02	47·15	5·93	.....	9853	7
Red Deer river, 7 miles above Hunter hill	3′–6″	2·04	13·06	33·75	44·17	9·02	.....	9046	7
Red Deer river, 9 miles above Hunter hill	1′–6″	1·83	13·63	34·01	39·11	13·25	.....	.....	7
Red Deer river, 13 miles above Hunter hill	1′–3″	1·98	12·62	35·99	42·81	8·58	.....	.....	7
South Saskatchewan river, 10½ miles above Medicine Hat	4′–0″	1·94	17·70	29·90	48·56	3·84	.....	.....	7
South Saskatchewan river, 10 miles above Medicine Hat	4′–0″	1·83	16·82	31·90	43·98	7·30	.....	9259	7
Stair, No. 6 level, 320 feet in	5′–0″	1·55	20·54	33·26	41·15	5·05	.....	.....	7
Stair, outcrop of main seam	5′–0″	1·59	19·90	33·33	41·58	5·19	.....	.....	7

BELLY RIVER COALS, PEACE RIVER DISTRICT.

Peace river at "Canyon of Mt. of Rocks"	0′–6″	6·40	2·10	21·54	71·63	4·73	.....	.....	7
Pine river, 5 miles above lower forks	2′–0″	3·39	2·45	33·76	48·69	15·10	.....	11331	7
Pine river, Coal brook, 2½ miles east of Forks	0′–6″	2·77	7·83	34·21	52·09	5·87	.....	.....	7
Pine river, Coal brook, 2½ miles east of Forks	1′–0″	3·32	1·39	23·11	31·38	44·12	.....	.....	12
Pine river, Canyon creek	1′–0″	9·26	0·67	17·23	77·34	4·76	.....	.....	12
Pine river, East Fork	1′–0″	3·01	1·70	43·76	50·10	4·44	.....	.....	12
Smoky river, 5 miles below Little Smoky river	0′–2½″	2·31	11·52	34·83	49·47	4·18	.....	.....	7

EDMONTON COALS, FOOTHILLS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Upper Belly river, northern part: tp. 3, R. 27	1′-0″	2·87	3·91	38·01	46·75	11·33	.....	11887	7
Indian farm, Pincher creek	2′-0″	3·14	5·38	33·19	52·34	9·09	.....	11234	7
Four miles south of Pincher creek near above	.....	3·10	6·26	31·96	53·05	8·73	.....	.....	7
Crowsnest river, near Lundbreck, upper	3′-0″	3·10	3·27	32·53	44·38	19·82	.....	10764	7
Crowsnest river, near Lundbreck, lower	3′-0″	3·00	2·36	40·66	47·78	9·20	.....	12236	7
Highwood river, N. Fork 5 miles up	1′-6″	2·98	6·12	31·92	49·88	12·08	.....	10764	7
Jumpingpound creek (Towers mine) N.W. ¼ sec. 19, tp. 25, R. 4, west of 5th	4′-6″	1·98	5·00	52·10	35·20	7·07	.....	.....	17
Fish creek (Shaws mine): sec. 7, tp. 22, R. 3, west of 5th	2′-0″	3·54	3·76	33·91	56·37	5·96	.....	.....	17
Sheep Creek coal mine: sec. 2, tp. 20, R. 3, west of 5th	4′-0″	3·26	3·08	39·37	54·50	3·05	.....	.....	7
Bow river, near Coal creek: sec. 22, tp. 27, R. 5, west of 5th	1′-8″	3·38	2·79	36·90	53·40	6·91	.....	.....	7
Coal creek, Bow river, outcrop of seam	4′-6″	2·90	4·93	33·55	46·21	15·31	.....	10579	7
Bow river, Bow River mine, south side	.....	2·78	4·41	40·32	48·27	7·00	.....	.....	7
Red Deer river, 4 miles below Williams creek	9′-0″	3·09	4·97	36·87	54·05	4·11	.....	.....	7
Rocky Mountain House seam, average of 3	2′-0″	2·50	7·44	36·56	46·02	7·85	.....	.....	7

EDMONTON COALS, FOOTHILLS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Head of Pembina and McLeod rivers	24′–0″	3·48	4·32	33·43	56·49	5·14	0·17	.....	14
Wolf creek: tp. 52, R. 15, west of 5th.	.....	2·32	8·57	40·39	46·74	4·30	.....	.....	14
McLeod river, Jocks crossing	.....	2·13	10·21	38·17	43·52	8·10	.....	.....	14
McLeod river near G.T.P., tp. 54	.....	2·33	9·47	39·24	48·25	3·04	.....	.....	14
Prairie creek, Athabaska river, Coal Creek branch, average of 3	2′–6″	2·79	4·80	33·25	43·10	18·91	0·38	10116	14
Prairie creek, Athabaska river, Coal Creek branch, average of 3	8′–0″	2·21	10·08	37·54	45·07	7·29	0·32	10007	14
Athabaska river, 20 miles above McLeod river	10′–0″	2·32	11·47	32·09	47·79	8·65	.....	9763	7
Athabaska river, 20 miles above McLeod river	3′–0″	2·46	10·58	32·79	50·19	6·44	.....	.....	7

EDMONTON COALS, EASTERN AREAS.

Bow river, Horseshoe bend	4′–4″	1·83	13·67	37·16	40·50	8·67	.....	.....	7
	.....	1·97	11·13	38·75	40·93	9·19	.....	.....	7
Blackfoot crossing, Bow river, in coulee 6½ miles east of crossing on south side of seam, 1 ft. of shale near top	4′–8″	2·39	11·91	33·25	51·57	3·27	.....	9956	7
Bow river, 4 miles below Blackfoot crossing	4′–6″	2·18	10·72	32·63	42·72	13·93	.....	.....	7
Crowfoot creek, 4 miles from Bow river	6′–0″	2·24	11·25	35·59	47·24	5·92	.....	.....	7

EDMONTON COALS, EASTERN AREAS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Crowfoot creek, upper seam near mine	1′-6″	2·16	13·20	33·80	48·10	4·90	.....	.....	7
Crowfoot creek, bottom of shaft at mine	9′-0″	2·06	10·35	34·40	39·61	15·64	.....	.....	7
Red Deer river, 2 miles below Rosebud river	5′-0″	2·07	14·20	34·22	47·91	3·67	.....	.....	7
Red Deer river, mouth of Rosebud river	6′-0″	2·16	13·08	34·50	48·34	4·08	.....	9625	7
Red Deer river, 4 miles below Tail creek	3′-0″	2·34	10·02	32·11	45·19	12·68	.....	.....	7
Red Deer river, 12 miles above Tail creek	7′-0″	2·30	7·66	25·90	34·53	31·91	.....	.....	7
Knechills creek	.....	2·00	13·28	36·39	43·84	6·91	.....	.....	12
Knechills creek, R. 23, west of 4th	4′-0″	2·35	9·86	34·89	46·57	8·68	.....	.....	7
Meeting creek, 2 miles from Battle river	4′-6″	2·28	11·68	35·82	49·88	2·62	.....	.....	7
Egg creek, North Saskatchewan river	1′-1″	2·10	11·91	36·39	45·04	6·66	.....	.....	7
North Saskatchewan river, Ross seam, Edmonton	4′-0″	2·25	11·47	36·12	48·57	3·84	.....	.....	7
North Saskatchewan river: Edmonton	6′-0″	2·26	12·89	33·79	50·57	2·75	.....	9372	7
" " " Big seam	26′-0″	2·12	14·78	30·48	48·67	6·07	.....	9520	7
" " " " " average of 3	.....	2·18	11·88	35·31	47·06	5·08	.....	.....	7
Towtinow river, tp. 63	.....	1·61	19·45	34·34	41·86	4·35	.....	.....	12
Pembina river: tp. 52, R. 7, west of 5th	.....	2·04	10·87	33·46	51·70	3·97	.....	.....	14
Pembina river: secs. 27 and 28, tp. 53, R. 7, west of 5th	.....	2·03	14·58	34·82	47·60	3·00	.....	.....	14

EDMONTON COALS, EASTERN AREAS.

Localities	Thickness of seam	Split vol. ratio	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Pembina river: sec. 33, tp. 53, R. 7, west of 5th	13′–0″	2·11	12·93	31·96	45·11	10·00	.....	.....	11
Pembina river: sec. 33, tp. 53, R. 7, west of 5th	13′–0″	2·13	13·78	32·01	47·35	6·86	.....	.....	11
Pembina river at old C.P.R. location	6′–0″	2·18	13·07	32·03	47·56	7·34	.....	.....	11
West end Cypress hills, Lodge creek	4′–0″	1·61	16·37	35·58	37·23	10·82	.....	.....	7

TERTIARY COALS, SASKATCHEWAN AREAS.

Wood mountain, 1st hill, highest	8′–0″	1·49	18·61	39·11	37·57	4·71	.....	.....	7
Wood mountain, 1st hill, lowest	5′–0″	1·93	12·26	41·51	43·07	3·16	.....	.....	7
Wood mountain near 3rd meridian, average of 2	Thin.	1·80	16·51	34·17	43·62	5·69	.....	.....	8
Wood mountain, Hay flat	6′–0″	1·72	13·73	38·91	38·54	8·82	.....	.....	7
Wood mountain, Poplar river at Boundary, average of 2	18′–0″	1·49	14·46	43·90	32·66	8·97	.....	.....	7
Big Muddy creek at Boundary	4′–0″	1·31	15·51	51·33	28·44	4·72	.....	.....	7
" " "	5′–0″	1·31	16·28	50·26	29·18	4·28	.....	.....	7
" " "	3′–0″	1·30	15·20	51·27	27·61	5·92	.....	.....	7
Big Muddy creek at Boundary, lowest seam	.....	1·27	18·74	46·19	30·04	5·03	.....	.....	7
Dirt hills, Middle bluff, lowest seam	6′–0″	1·87	15·50	35·96	44·78	3·76	.....	.....	7
Souris river: tp. 3, R. 15, west of 2nd	1′–6″+	2·15	13·85	30·95	47·90	7·30	.....	.....	16
" mouth of Long creek, top	6′–6″	1·28	17·97	47·32	30·10	4·61	.....	.....	7
" " "	1′–0″	1·58	14·90	43·24	36·68	5·18	.....	.....	7
" " "	1′–5″	1·38	12·67	53·90	28·01	6·42	.....	.....	7
" " "	3′–2″	1·70	13·94	41·92	38·35	5·79	.....	.....	7

TERTIARY COALS, SASKATCHEWAN AREAS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Souris river, sec. 22, tp. 1, R. 8, west of 2nd	7′–0″	1·77	15·11	38·66	41·67	4·56	.....	.....	7
Souris river, sec. 14, tp. 1, R. 8, west of 2nd	7′–0″	1·50	14·73	48·40	34·07	2·80	.....	.....	7
Souris river, N. side, 1 mile west of Short creek	2′–3″	1·76	12·07	46·28	38·90	2·75	.....	.....	7
Souris river, Sutherland's mine	4′–0″	1·42	21·84	35·12	38·64	4·40	.....	.....	7
Souris river, near Roche Percee	.....	1·30	20·29	31·41	31·35	16·95	.....	.....	12
Souris river, Selwyn's bore-hole, sec. 6, tp. 2, R. 5	6′–0″	1·68	17·78	32·70	41·17	8·35	.....	.....	7

OUTLYING LOCALITIES, HORIZON NOT DEFINITE.

Drift coal, 7 miles below Prince Albert	.....	2·32	10·12	35·98	47·27	6·63	.....	.....	7
Stream running to Lac la Ronde, reported as	5′–0″	1·76	13·25	28·97	34·56	23·22	.....	.....	14
Sanders river: Swan river, Manitoba, thin seam	.....	1·92	18·82	28·03	49·00	4·15	.....	.....	7
Fort Francis, Rainy river, loose coal	.....	1·86	15·45	33·70	43·45	7·40	.....	.....	16
Moose river, Ont., below Long Portage	.....	1·99	11·74	41·39	44·03	2·84	.....	.....	7

BRITISH COLUMBIA COALS, VANCOUVER ISLAND.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Comox—									
Union colliery			9·61	16·30	68·25	5·92	0·36		1
Union colliery, No. 5 pit, upper seam		4·56	1·08	29·24	57·03	9·60	3·05	13261	6
Coal from near Hamilton lake		4·88	1·70	22·82	47·72	27·00	0·76	10626	6
Union colliery, No. 4 slope, Comox seam		5·18	0·88	27·34	61·82	8·70	1·26	13881	6
Union colliery, No. 5 pit, Comox seam		5·11	1·32	27·62	63·64	6·70	0·72	14191	6
Union colliery, No. 6 pit, Comox seam			1·26	27·33	63·49	6·80	1·12	14191	6
Union colliery, upper seam	4′–4″		1·34	30·01	65·82	2·83			7
Union colliery, lower seam			1·70	32·36	63·08	2·86			...
Union colliery, 10 ft. seam, upper part			1·70	27·17	68·27	2·86			7
Trent River seam	3′–8″		0·92	32·94	58·32	7·82			7
"	3′–8″		0·97	29·95	61·56	5·95			7
Browns River seam	1′–8″		0·95	23·85	70·86	4·34			7
Beaufort mine, slow coking				29·30	55·75	14·95			7
Baynes Sound mine, Richardson seam			1·18	34·13	48·51	16·18			7
Baynes Sound mine, slow coking, upper			29·10		57·48	13·42			7
Baynes Sound mine, slow coking, lower			29·55		64·70	5·75			7
Nanaimo—									
New Vancouver, commerical coal			2·06	34·07	56·94	6·67	0·25		1
Nanaimo colliery			5·35	33·76	46·00	14·32	0·56		3

BRITISH COLUMBIA COALS, VANCOUVER ISLAND.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Nanaimo colliery, No. 1 shaft, esplanade			1·88	33·27	54·67	9·40	0·78	12672	6
Nanaimo colliery, No. 1 shaft, lower seam			2·86	35·84	54·79	5·5	1·01	12951	6
Nanaimo colliery, Harewood mine			1·58	33·84	52·17	11·85	0·56	12238	6
Nanaimo colliery, No. 5, Southfield mine		3·71	2·08	35·78	56·26	5·60	0·28	13261	6
Wellington mine, commercial sample			8·57	25·30	56·40	9·52	0·21	.....	1
Wellington mine			4·14	36·85	46·16	12·85	0·56	.....	3
"		3·29	2·75	38·03	52·64	6·58	.....	12567	7
Extension collieries: Tunnel vein			1·44	31·40	46·18	20·65	0·33	11401	6
" lower part			1·52	35·27	57·04	5·85	0·32	13416	6
" top vein			1·24	36·49	53·72	8·20	0·35	13261	6
" bottom vein			1·28	35·26	55·83	7·30	0·33	13199	6
North End of Island—									
Old H. B. Co. mine, Sukwash, near Fort Rupert			2·84	39·23	46·36	11·57	.....	.....	7
Old H. B. Co. mine, Sukwash, near Fort Rupert			5·03	41·51	46·52	6·94	.....	.....	7
Three-fourth mile south of Kliksiwi River seam	1′–4″		3·65	42·23	39·84	14·28	.....	.....	7
Kink river, near Beaver Harbour seam	0′–6″		3·68	39·29	47·03	10·00	.....	.....	7
Quatsino sound, Koskeemo—									
Koskeemo coal fields	3′–0″		1·05	34·38	54·01	10·56	.....	.....	7

BRITISH COLUMBIA COALS, QUEEN CHARLOTTE ISLANDS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Yakoun river, Masset inlet	18′–0″	.....	2·65	38·19	53·73	5·43	.....	.....	7
Skidegate channel, Cowgitz, Hooper creek	.....	.....	1·99	7·65	80·62	9·74	.....	.....	7
Skidegate channel, Cowgitz, Nicholsons creek	.....	.....	1·60	5·02	83·09	8·76	1·53	.....	7
Skidegate channel, Cowgitz, Nicholsons creek, 3 ft. seam	.....	.....	1·89	4·77	85·76	6·69	0·89	.....	7
Camp Anthracite, Graham island	.....	.....	1·52	8·69	80·07	9·72	.....	.....	7
" " " "	.....	.....	2·85	7·59	68·25	21·31	.....	.....	7
Camp Wilson, Graham island, seam	17′–0″	.....	2·47	35·25	59·36	2·92	.....	.....	7
			1·91	35·24	59·39	3·46	.....	.....	7
			1·06	43·48	46·01	9·45	.....	.....	7
Camp Robertson, Graham island, seam	6′–0″	.....	0·80	23·27	51·39	24·54	.....	.....	7
Camp Robertson, Graham island, seam	6′–0″	.....	1·33	35·25	48·89	20·85	.....	.....	7
			1·20	29·13	47·52	22·15	.....	.....	7

BRITISH COLUMBIA COALS, MAINLAND.

Nicola river and vicinity—									
Coldwater river, Coal Gully creek, tunnel on lower seam	18′–6″	.....	3·04	37·18	52·05	7·73	.....	.....	7 and 12
Coldwater river, Coal gully, upper seam	15′–4″	.....	5·78	27·65	52·69	13·88	.....	.....	7

BRITISH COLUMBIA COALS, MAINLAND.

Localities.	Thickness of seam	Split vol. ratio	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Coldwater river, Coal gully	13′–6″	.....	3·35	26·55	59·30	10·80	.....	.....	18
Coldwater river, Southern outcrop, seam	7′–10″	.....	3·17	35·73	55·25	5·85	.....	.....	7
Coldwater river, near Nicola river, upper seam	6′–0″	.....	2·13	27·99	59·66	10·22	.....	.....	18
Junction of Nicola and Coldwater	.....	.....	4·45	33·79	53·05	8·71	.....	.....	7
North mouth of Coldwater lower tunnel	7′–6″	.....	1·37	38·24	54·25	6·14	.....	.....	7
Nicola river, near Coldwater, average of 2 slow coking	.....	.....	36·065	.....	61·29	2·64	.....	.....	7
Nicola river from boring on Indian reserve	.....	.....	1·32	29·01	41·47	28·20	.....	.....	14
Quilchena river, lot 1,267	6′–0″	.....	6·95	37·21	47·95	7·89	.....	.....	7
West side Okanagan lake, B.C., seam	2′–0″	3·89	1·59	33·95	55·36	9·10	.....	.....	14
Collins gulch, Tulameen river: seam	12′–0″	.....	4·62	41·16	49·04	5·18	.....	.....	7
" " seam	2′–6″ and 4′–8″	.....	4·87	36·86	50·99	7·28	.....	.....	7
" " large seam	.....	.....	3·26	43·33	49·70	3·71	.....	.....	14
Collins gulch, Tulameen river: seam	15′–0′ to 20′–0″	.....	7·87	30·59	51·10	10·44	.....	.....	18
Princeton: seam near town	11′–4″ and 13′–4″	.....	11·97	30·49	49·21	8·33	.....	.....	18
" "	.....	.....	16·17	37·58	41·67	4·58	.....	.....	11
Similkameen river, 6 miles south Vermilion Forks	.....	.....	50·13	.....	42·67	7·20	.....	.....	7
Chilliwak river, 5 miles up	.....	.....	35·73	.....	63·88	0·41	.....	.....	7
Hat creek, 1 mile above Marble canyon, Bonaparte River seam	26′–0″	.....	8·60	35·51	46·84	9·05	.....	.....	7
North Thompson river, 45 miles up	.....	.....	2·22	38·10	46·74	12·92	.....	.....	7
Kohasganko river	.....	.....	9·90	42·61	33·95	13·54	.....	.....	7

BRITISH COLUMBIA COALS, MAINLAND.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Fort Fraser, Nechako river			10·46	41·44	43·21	4·89			7
Skeena river, 9 miles above Forks			1·05	19·09	38·96	40·90			7
Skeena river, 20 miles above Forks			1·52	7·20	46·04	45·24			7
Skeena river, Watsonkwa river, slow			40·52		57·51	1·97			7
Morice river, Skeena river: Seam No. 1			4·32	28·86	54·62	12·20			14
Morice river, Skeena river: Seam No. 2, top			4·48	25·91	55·57	14·04			14
Morice river, Skeena river: bottom			3·59	28·18	53·94	14·29			14
"	5′–6″		1·36	10·87	80·82	6·95			15
"	7′–3″		0·80	11·10	78·90	9·20			15
"	4′–0″		0·58	10·80	82·70	5·90			15
Tooza river, 16 miles up from Stikine			4·59	33·77	42·67	18·97			7
Goat creek, Telkwa river, Transcontinental seam	2′–4″		0·80	8·20	81·60	9·40			11
Goat creek, Telkwa river, Transcontinental seam	6′–0″		0·90	9·90	75·80	13·40			11
Goat creek, Telkwa river, lower seam	14′–0″		0·98	9·94	80·76	8·32			12
Goat creek, Cassiar Coal Co. area, top seam	7′–7″		1·92	30·45	61·30	6·33			11
Goat creek, middle bench			4·70	30·40	60·80	4·10			11
Goat creek, middle bench, lower part			6·60	29·00	56·90	7·50			19
Hudson Bay mountain, Telkwa river			9·16	5·63	74·70	10·51			14

YUKON TERRITORY COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Whitehorse Coals—									
12 miles S.W. Dugdale station, seam.	9′–6″	14·14	2·15	6·01	69·86	21·98	.....	.....	14
" " seam.	2′–6″	8·40	3·76	8·34	62·50	25·40	.....	.....	14
" " seam.	10′–4″	4·93	3·78	10·06	38·38	47·78	.....	.....	14
" " seam.	6′–0″	8·04	2·35	6·65	42·27	48·73	.....	.....	14
" " not named	.....	4·74	3·83	15·84	47·81	32·52	.....	.....	7
12 miles S.W. Dugdale station, average of 2	.....	14·50	2·03	5·64	67·89	24·43	.....	.....	7
Tantalus Butte (Millers working) opposite Tantalus mine, seam.	5′–0″	2·71	9·48	32·28	53·51	4·73	.....	.....	14
Tantalus Butte (Millers working) opposite Tantalus mine, seam.	.....	4·80	0·45	28·74	56·74	14·07	.....	.....	12
Tantalus mine, Lewes river—									
Tantalus mine, top seam	3′–0″	5·87	0·82	25·12	66·03	8·03	.....	.....	14
" middle seam	6′–11″	5·40	0·76	24·74	58·60	15·90	.....	.....	14
" bottom seam	8′–0″	5·33	0·75	23·62	55·21	20·43	.....	.....	14
Five Fingers mine, Lewes River seam	2′–0″	2·65	4·26	40·26	44·67	10·81	.....	.....	14
" "	2′–6″	2·59	6·42	36·98	46·03	10·57	.....	.....	7
" "	3′–0″	2·75	6·03	36·92	49·03	8·02	.....	.....	7
Yukon River Coals—									
Cliff creek, 2½ miles up, upper workings	.....	2·25	8·57	42·04	45·77	3·62	.....	.....	7
Cliff creek, 2½ miles up, lower workings	.....	2·18	10·58	40·10	46·74	2·58	.....	.....	7
Lepine creek, Rock creek, Yukon river	.....	1·90	14·38	34·26	42·80	8·56	.....	.....	7

YUKON TERRITORY COALS.

Localities.	Thickness of seam.	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Coal creek, Rock creek, Yukon river: seam	3′-0″	1·63	18·31	34·96	40·88	5·85	.....	.....	7
Coal creek, Rock creek, Yukon river: seam lower	.....	1·49	19·37	33·85	37·45	9·33	.....	.....	7
Coal creek, Yukon river: seam	4′-0″ to 11′-0″	2·77	6·03	38·44	50·53	5·00	.....	.....	12
Coal creek, Yukon river, 7 miles up	12′-6″	2·49	7·24	41·45	48·91	2·40	.....	.....	7
Ruby creek, Indian river, Yukon, 7 miles up	.....	3·81	4·68	29·88	60·06	5·38	.....	.....	12

NOVA SCOTIA COALS.

The recent examinations or tests of coal will supersede these old records. Many of these are slow coking and exclude the moisture.

Pictou Coals—									
Acadia mines (Albion mines), McGregor seam	.....	.....	32·00		59·30	8·70	.....	.....	7
Acadia mines (Albion mines), McGregor seam, top bench	.....	.....	22·50		65·70	11·80	.....	.....	7
Acadia mines (Albion mines), McGregor seam, 2nd bench	.....	.....	23·30		70·00	6·70	.....	.....	7
Acadia mines, Stellar (coal seam)	.....	.....	33·58		62·09	4·33	.....	.....	7
" " (stellarite)	.....	.....	66·56		25·23	8·21	.....	.....	7
" " (shale)	.....	.....	30·65		10·88	58·47	.....	.....	7
" Acadia seam, slow	.....	.....	2·10	32·27	57·57	7·55	0·56	.....	7
" " "	.....	.....	2·10	29·20	61·15	7·55	1·48	.....	24
Foord pits; main seam	.....	.....	1·73	28·18	62·94	7·15	0·32	.....	7

NOVA SCOTIA COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Foord pits; main seam			1·48	24·28	66·50	7·74	0·55		7
Albion mines: Deep seam, slow coking			1·29	25·44	61·65	10·25	0·86		7
" " "			0·75	20·34	68·50	10·41	0·94		24
Crown Pottery pit: Richardson seam			0·76	38·84	55·81	5·09			7
Old Fraser mine, Foster seam			29·00		53·14	17·60			7
Lawsons slope, Lawson seam			25·40		50·00	24·60			7
Marsh colliery, Geo. Mackay seam			29·85		62·22	7·98			7
McBeans slope, McBean seam, 1st bench			1·57	29·29	52·36	16·76			7
			2·67	28·65	49·66	19·42			7
McBeans slope, McBean seam, 2nd bench			2·67	27·20	54·86	15·27			7
			1·94	23·95	57·17	16·94			7
McBeans slope, McBean seam, 3rd bench			2·22	30·23	59·70	7·85			7
			3·00	29·61	59·51	7·88			7
Montreal and Pictou mines, 1st bench, slow coking			4·40	24·95	61·07	9·58			7
Montreal and Pictou mines, 2nd bench, slow coking			5·47	19·30	68·55	6·05			7
Nova Scotia colliery, Acadia seam, top			32·68		62·08	5·24			7
Nova Scotia colliery, Acadia seam, middle			32·39		62·40	5·21			7
Nova Scotia colliery, Acadia seam, bottom			33·45		61·41	5·14			7
Drummond colliery, Acadia seam, top coal, fast coking			0·72	29·21	60·35	9·46	0·26		7
Drummond colliery, Acadia seam, Fall coal			1·56	30·13	60·32	7·56	0·42		7

Localities.	Thickness of seam	Split vol. ratio	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Drummond colliery, Acadia seam, 1st bench			1·80	31·72	55·39	10·50	0·54		7
Drummond colliery, Acadia seam, 2nd bench			1·31	28·66	60·31	8·67	1·04		7
Drummond colliery, Acadia seam, 3rd bench			1·43	29·32	59·89	8·79	0·56		7
Drummond colliery, Acadia seam			1·52	29·46	60·19	9·10	1·62		24
Springhill Coals—									
Black mine, main seam (West slope No. 2)			1·21	33·08	61·49	4·22	0·25		7
Black mine, main seam			0·98	35·52	59·42	4·08			7
Styles mine			4·05	38·18	51·37	6·40			7
Styles mine			3·72	37·73	47·73	10·89			7
Black river, Cumberland co.			3·73	34·33	47·96	13·98			7
Inverness mines (Broad Cove mines) Inverness co.: seam	5′–0″		7·78	34·51	46·03	11·68			7
Inverness mines (Broad Cove mines) Inverness co.: seam	7′–0″		4·02	25·39	65·19	5·40			7
Inverness mines (Broad Cove mines) Inverness co.: seam	3′–0″		7·92	34·71	46·60	10·77			7
Inverness mines (Broad Cove mines) Inverness co.: seam	3′–0″		8·49	36·82	48·40	6·29			7
Inverness mines (Broad Cove mines) Inverness co.: seam	3′–9″		8·45	36·52	48·78	6·25			7
Port Hood mines, Inverness co., 150 ft. on slope			4·02	38·81	49·65	7·52			7

NOVA SCOTIA COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile mcobustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Port Hood mines, Inverness co., 1150 ft. down slope, face of slope			2·11	38·86	49·25	9·78			
Port Hood mines, Inverness co., south level			2·47	38·48	50·39	8·66			7
Port Hood mines, Inverness co., north level			2·42	37·18	50·96	9·44			7
Mabou coal mines			5·29	41·87	50·08	2·76			14
Sydney Coals—									
Gowrie seam			0·50	28·13	66·10	5·36	1·75		24
Hub seam, Little Glace Bay mines, slow coking	7′–6″		36·54		62·53	0·93			7
Hub seam, Little Glace Bay mines, slow coking			28·62		65·85	3·24	2·29		7
Block House seam, Block House mine, slow coking	8′–10″		38·80		55·80	5·40			7
Block House seam, Block House mine, slow coking			31·90		62·79	5·27	3·76		7
Harbour seam, International mine, slow coking	6′–1″		38·50		56·50	5·00			7
Harbour seam, International mine, slow coking			34·09		62·92	2·99	2·26		7
Harbour seam, Little Glace Bay mine, slow coking	5′–0″		30·21		67·78	2·01	0·90		7
Victoria seam, Victoria mine, slow coking	6′–7″		38·70		58·40	2·96			7
Sydney Main seam, Sydney mine, slow coking	6′–0″		26·94		65·57	5·49			7

NOVA SCOTIA COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Sydney Main seam, Sydney mine, slow coking			31·87		64·59	3·54			7
Sydney Main seam, Sydney mine, slow coking			34·18		61·50	4·32	1·24		7
Sydney Main seam, Sydney mine, slow coking			32·74		61·54	5·72			7
Sydney Main seam, Sydney mine, slow coking			1·53	36·36	57·01	5·08	1·89		24
McAuley seam, Gowrie mines, slow coking	4′–11″		36·15		58·07	5·70			7
McAuley seam, Gowrie mines, slow coking			32·07		64·43	3·50	2·86		7
Phelan seam, Caledonia mine, slow coking	8′–0″		37·26		58·39	4·35			7
Phelan seam, Caledonia mine, slow coking			35·47		61·67	2·86	2·06		7
Phelan seam, Reserve mine			1·00	36·26	58·39	4·35	2·47		7
" "			34·50		59·50	6·00			7
" "			4·92	30·13	59·52	4·26	1·16		3
" Bridgeport mine, slow coking			33·20		61·39	5·41			7
Phelan seam, Clyde mine, slow coking	8′–6″		33·00		57·37	9·63			7
" " "			32·82		64·33	2·85	2·17		7
Phelan seam			0·52	34·21	59·73	3·92	0·81		24
International seam			0·80	27·55	65·90	4·30	1·45		24
Emery seam			0·64	31·10	63·10	3·65	1·51		24
Lingan Main seam, Lingan mine, slow coking	5′–8″		30·03		66·91	3·06			7
			34·23		63·98	1·79	0·77		7

NOVA SCOTIA COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Ross seam, Schooner Pond mine, slow coking	6′–11″	.....	38·10		58·45	3·45	.....	.....	7
Ross seam, Schooner Pond mine, slow coking	.....	.....	31·75		66·85	1·40	1·21	.....	7
Collins seam, Little Bras d'Or mine, slow coking	5′–0″	.....	1·63	35·12	59·19	6·06	.....	.....	7
Gardiner seam, Gardiner mine, slow coking	4′–8″	.....	34·33		61·97	3·70	.....	.....	7
Gardiner seam, Gardiner mine	.....	.....	31·96		65·22	2·82	1·18	.....	7
Lorway seam, Reserve mine, slow coking	4′–0″	.....	24·47		55·98	13·28	6·27	.....	7
Tracey seam, Tracey mine	.....	.....	2·23	30·09	66·61	0·98	.....	.....	7
Fraser seam, Sydney harbour, slow coking	.....	.....	31·40		62·40	6·20	.....	.....	7
Carroll seam, Bridgeport basin, slow coking	4′–0″	.....	32·80		61·40	5·80	.....	.....	7
Indian Cove seam	.....	.....	1·82	34·94	56·97	6·27	.....	.....	7
Various Outlying Occurrences.									
Hants co.: Small seam in the Gore	.....	.....	1·90	23·90	49·40	24·80	.....	.....	11
Cariboo cove, from 200 ft. level	.....	.....	0·98	25·68	52·10	21·24	.....	.....	14
Little river, Inhabitants basin, slow coking	.....	.....	30·25		56·40	13·35	.....	.....	7
Caribacou. Near Inhabitants basin, slow coking	.....	.....	25·20		44·70	30·10	.....	.....	7
Big pond, East bay, slow coking	.....	.....	41·79		44·98	13·23	.....	.....	7

NEW BRUNSWICK COALS.

Localities.	Thickness of seam	Split vol. ratio.	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Little Lepreau			1·25	5·83	56·04	36·88			7

WELSH COALS.

Glen Neath			3·39	14·25	78·74	3·62	0·121		3
Albion Cardiff			2·79	14·91	69·92	12·38	0·777		3
Castle Gate			3·35	38·66	48·63	9·36	0·200		3
Albion Methyr			2·64	19·94	71·26	4·83	1·316		1
Albion Methyr			3·19	15·09	68·11	13·51	0·099		1
Albion Cardiff			2·81	8·646	85·16	3·24	0·138		2
Bryn Blaen			1·95	7·40	84·60	6·05	0·198		3

NEW ZEALAND AND AUSTRALIAN COALS.

New Zealand: Westport coal			2·65	34·93	61·80	0·20	0·42		3
Australia: Duckenfield coal			4·05	29·22	58·68	8·05	0·27		3
Australia: N.S.W., Hetton, Bullock island			3·17	32·99	60·04	3·80	0·17		3
Australia: N.S.W., Wallsend, Newcastle			4·70	28·73	60·39	6·00	0·17		3
Australia: N.S.W., Wallsend, Newcastle			7·16	23·28	56·01	13·16	0·38		3

UNITED STATES COALS.

In the St. Louis tests fresh coal from car lots was examined and the loss on air drying has been put in second column. The Navy trials separated non-combustible gas from moisture, in these tables it has been added to moisture.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Alaska Coals [1]—									
Matanuska Coals—									
Coal creek, ¾ mile above Matanuska river. Seam	5′–0″	0·80	2·24	23·08	70·21	4·47	0·50	.....	.....
Tsadaka creek, 4½ miles above trail. Seam	11′–8″	4·60	10·05	36·05	48·90	5·00	0·25	.....	.....
Tsadaka creek, 4 miles above trail. Seam	6′–0″	.....	4·03	34·84	49·31	11·82	0·38	.....	.....
Matanuska river, 3 miles above Chickaloon creek	7′–0″	1·60	4·36	18·92	61·19	15·53	0·37	.....	.....
Chickaloon creek, Watsons tunnel, No. 3	7′–0″	1·00	2·46	17·01	53·23	27·30	0·84	.....	.....
Chickaloon creek, Watsons tunnel, No. 2	12′–3″	1·60	2·58	19·14	67·46	10·82	0·57	.....	.....
Kings creek at upper bridge	9′–10″	1·80	2·93	21·85	63·09	12·13	0·59	.....	.....
Coal creek, ⅝ mile above Matanuska river	8′–7″	4·10	6·70	14·96	65·83	12·47	0·44	11968	.....
Chickaloon creek, Watsons tunnel, No. 5	7′–10″	1·90	2·90	17·47	56·15	23·48	0·46	.....	.....
Matanuska valley between Boulder and Hicks creeks	38′–0″	.....	2·55	7·08	84·32	6·05	0·57	13710	.....
Eska creek, 3 miles above trail	3′–3″	.....	6·60	34·30	48·23	10·87	0·41	11340	.....

[1] Analysis as given in U. S. Geol. Survey Bull. No. 290.

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Chickaloon creek, Watsons tunnel, No. 2	5′–2″	.....	0·90	19·60	74·60	4·90	0·60	14868	.....
Bering River Coals—									
Lower end of Gorge, Tokun creek	6′–8″	3·70	4·35	11·97	73·34	10·34	1·13	.....	.....
Christopher's opening, branch of Dick creek	10′–0″	5·20	6·03	12·98	78·40	2·59	0·70	.....	.....
Christopher's lower tunnel, Dick creek	8′–7″	5·10	5·84	11·74	60·21	22·21	3·36	.....	.....
Queen creek, opening on lower seam	31′–0″	4·60	5·66	13·65	76·81	3·88	0·77	.....	.....
Queen creek, opening on upper seam	27′–0″	3·00	4·23	14·03	79·75	1·99	0·96	.....	.....
Carbon Creek tunnel	11′–0″	3·70	4·22	13·37	78·80	3·61	1·56	.....	.....
Carbon Creek tunnel, near mouth of	19′–7″	5·40	5·95	13·01	76·12	4·92	0·01	.....	.....
South branch Queen creek	17′–0″	3·90	4·94	13·34	77·29	4·43	0·83	.....	.....
Kushtaka river, tunnel, 710 ft. above lake	18′–0″	1·90	2·68	11·06	73·31	12·95	5·27	.....	.....
Cunninghams upper tunnel, Trout creek	8′–0″	1·30	2·11	16·58	79·68	1·63	0·78	.....	.....
North end of Hunts hillside trail, Carbon mountain	15′–0″	5·20	5·93	6·76	81·47	5·84	0·82	.....	.....
Lower seam east side Carbon mountain	4′–8″	6·20	7·26	6·64	75·89	10·21	1·27	.....	.....
Head of First Berg lake, Carbon mountain	2′–2″	1·90	3·74	5·41	85·92	4·93	1·10	.....	.....
Head of Fourth Berg lake, Carbon mountain	2′–8″	4·70	7·67	5·78	66·03	20·52	2·90	.....	.....
Carbon mountain, west side of crest	2′–9″	1·50	4·43	10·14	80·78	4·65	0·51	13640	.....
Eastern opening hillside trail, Carbon mountain	15′–0″+	6·10	8·33	6·36	82·00	3·31	1·11	.....	.....

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Carbon mountain, west side of crest nearer summit	5′-3″	5·00	7·94	9·20	78·53	4·33	0·79	.....	.....
Carbon mountain, south end hillside trail, west side	10′-0″	7·00	8·31	7·12	82·43	2·14	1·05	.....	.....
Carbon mountain, west opening, east side of hill	10′-6″	13·20	13·89	5·01	73·87	7·23	0·82	12137	.....
Trout Creek tunnel, ¼ mile below house	33′-0″	5·40	6·34	14·29	69·55	9·82	0·64	.....	.....
Alabama Coals—									
Horsecreek, Ivy C. & T. Co. mine No. 8	8′-0″	0·80	1·55	32·10	53·71	12·64	0·73	12958	4
Carbon hill, Chickasaw mine No. 5	4′-5½″	0·80	2·58	33·15	51·74	12·53	1·02	12449	4
Adger, Adger mine, Blue Creek bed	10′-10″	6·80	1·10	26·45	62·08	10·37	0·96	.....	4
Johns, Johns mine, Blue Creek bed	7′-6½″	1·70	0·95	26·95	60·66	11·44	0·99	.....	4
" "	7′-6½″	2·80	0·59	26·51	62·97	9·93	0·96	14040	4
Kellerman, Central mine, Brockwood bed	7′-2½″	2·80	1·04	31·06	57·61	10·29	1·53	.....	4
Brockwood, Slope No. 7, Milldale bed	2′-2″	1·50	0·47	32·03	61·89	5·61	1·12	14582	4
Brockwood, Drift No. 10, Carter bed	3′-0″	3·40	0·47	31·88	61·80	5·85	0·80	.....	4
Belle Sumpter, Blue Creek bed	.....	1·50	0·71	24·99	61·44	12·86	0·55	.....	4
" "	.....	3·70	0·79	23·16	49·83	26·22	1·37	.....	4
Searles. Brockwood bed	.....	1·30	1·06	32·79	58·92	7·23	1·39	.....	4
Tidewater. Brockwood bed	.....	0·80	1·29	34·96	52·10	11·65	1·58	.....	4
Jefferson co. Pearson Warrior coal	.....	.....	4·83	18·95	72·76	3·28	0·17	.....	1
" "	.....	.....	2·35	23·96	72·03	1·26	0·30	.....	1
Blocton Bibb Co. Cahaba coal	.....	.....	4·16	24·94	67·43	3·27	0·19	.....	1

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Blocton Bibb Co. Cahaba coal			3·22	25·70	64·33	6·70	0·05		1
Corona. Walker co. Corona coal			2·45	31·21	55·55	9·61	1·76		1
" " "			3·04	30·93	59·17	6·09	0·77		1
Coal valley, Walker co.			4·41	28·07	58·08	8·22	1·22		1
" "			3·98	31·22	55·75	6·65	2·40		1
Coalburg. Sloss coal			2·33	24·19	70·31	2·74	0·42		1
Milldale, Tuscaloosa co.			1·28	27·43	69·23	1·77	0·28		1
Jefferson co.: Pratt coal			1·89	26·27	69·32	2·32	0·19		1
" "			2·10	25·77	68·35	3·70	0·07		1
Aldrich, Monterallo coal			1·99	34·85	48·99	14·27	0·67		3
Gamble			2·78	24·67	61·96	10·59	0·43		3
Arkansas Coal—									
Huntingdon, Central Coal Co. Mine No. 3	7′–7″	2·10	1·17	17·83	68·12	12·88	1·27	13410	4
Bonanza, Jenny Lind Coal. Mine No. 12	3′–8″	1·50	0·74	16·26	73·66	9·34	1·90	13961	4
Jenny Lind. Western Coal Co. Mine 18	4′–8″	0·10	3·08	18·62	66·10	12·20	1·70	13477	4
Jenny Lind. Western Coal Co. Mine 18		3·00	0·82	14·32	70·62	14·24	1·30		4
Coalhill. Western co. Mine No. 4		1·10	1·28	12·82	73·69	12·21	2·01	13406	4
Jenny Lind, Huntingdon coal bed	6′–0″		0·95	17·91	71·52	9·62	2·07	14096	4
" "			0·80	17·20	74·35	7·65	1·64		4
Denning. Spadra bed	3′–7″		0·85	14·45	76·41	8·29	2·05		4
" "	4′–5″		0·84	16·46	75·32	7·38	1·91	14645	4
Midland City. Huntingdon bed	2′–10″		0·97	19·68	69·62	9·73	1·11	14022	4
" "	2′–9″		1·00	16·90	71·80	10·30	0·60		4

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Burma, Huntingdon bed	7′–7″	.....	0·80	17·80	72·71	8·69	1·95	14281	4
Bonanza, Sebastian co.	.....	.....	1·88	14·10	80·61	3·41	0·36	.....	3
California Coal—									
Tesla, Alameda co. Tesla mine	.....	4·50	18·02	39·22	26·39	16·37	3·07	8105	5
Colorado Coal—									
Lafayette. Simpson mine	11′–0″ to 14′–0″	6·00	13·49	37·11	43·03	6·37	0·58	10791	4
Canyon city	.....	.....	6·72	34·76	52·70	5·82	.....	.....	7
Erie and Canfield, mines near	.....	.....	14·80	34·50	47·30	3.40	.....	.....	7
Georgia Coal—									
Lookout mountain, Durham coal	.....	.....	2·24	14·59	80·07	2·92	0·17	.....	1
Illinois Coal—									
Benton. Benton mine	.....	4·60	8·31	31·65	49·56	10·48	1·55	11727	5
Bush. Bush No. 1 mine	.....	3·60	8·20	32·26	46·59	12·95	3·48	11362	5
Bush commercial sample	.....	.....	5·48	36·22	47·70	10·60	3·70	12262	4
Carterville Big Muddy Coal Co.	.....	5·80	8·86	31·25	48·23	11·66	2·46	.....	5
Centralia. Pettinger and Davis mine	.....	4·20	9·95	34·76	42·06	13·23	3·87	10960	5
Coffeen. Clover Leaf Shaft No. 1	.....	9·80	5·13	32·68	47·46	14·73	4·45	11158	4
Coffeen. Clover Leaf Shaft No. 1, mine sample	.....	8·10	11·93	29·99	43·90	14·18	4·29	10303	5
Collinsville. Dunk Bros. C. & C. Co. slack-washed	.....	12·50	5·16	34·98	40·67	19·19	3·76	10651	4
Collinsville. Lumaghi C. Co. Mine No. 2	.....	3·50	10·86	36·24	39·75	13·18	4·53	10816	5

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Herron. Mine No. 7, Williamson co.		4·00	8·43	30·08	51·89	9·60	1·14	11959	5
La Salle. La Salle shaft		8·40	12·39	36·89	41·80	8·92	3·92	11399	5
Marion. Mine No. 3, run of mine		2·70	5·96	30·29	52·16	11·59	1·77	12103	4
Troy. Dunk Bros. C. Co. No. 3 mine		1·70	11·40	32·45	44·30	11·85	1·34	10991	4
O'Fallon. W. A. Coal Co. Mine No. 1		3·70	6·28	38·92	41·08	13·72	4·25	11448	4
Paisley. Paisley mine		4·40	13·20	34·33	39·94	12·53	4·47	10514	5
Springfield. Capital Coal Co. No. 2 mine		8·00	12·77	34·68	40·77	11·78	4·16	10757	5
Zeigler. Franklin co.		5·60	10·72	29·86	50·06	9·36	0·91	11686	5
Staunton. Macoupin co.		9·00	13·54	35·69	40·03	10·74	4·03	10807	5
West Frankfort. Franklin co.		6·90	9·50	31·98	47·08	11·44	1·45	11506	5
Indiana Coal—									
Boomville. Electric mine		3·60	6·24	37·49	42·76	13·51	4·60	11538	4
Boomville. Wooley Coal Co., Mine No. 3		8·50	13·18	31·92	39·27	15·63	4·79	10030	5
Dugger. Island Coal Co., Mine No. 4		4·00	12·15	33·48	46·23	8·14	1·41	11761	5
Hymera. Consolidated Indiana Co. Mine 33		7·20	12·03	35·65	41·44	10·88	4·27	11192	5
Hymera. Consolidated Indiana Co. Mine 34		5·20	10·80	36·09	40·49	12·62	4·39	11185	5
Macksville. Red Bird mine		8·00	12·82	34·80	42·08	10·30	3·27	11119	5
Mildred. Mildred mine		3·00	8·66	34·86	42·67	13·81	2·58	11405	4
Littles. Littles mine		3·60	8·90	38·52	43·37	9·21	3·74	12008	5
Rosedale. Park Coal Co.		8·10	10·72	39·29	41·42	8·57	3·83	11767	5

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Star City Consolidated Indiana Coal Co., No. 29		10·80	13·99	29·40	42·29	14·32	2·31	10318	5
Terre Haute. Deep vein mine		4·60	9·55	36·19	43·65	10·61	3·72	11759	5
Indian Territory Coals—									
Alderson			3·28	32·38	57·34	7·00	0·20		
Hartshorne. Mine No. 8		2·80	1·70	37·19	49·79	11·32	1·56	12969	4
Henryetta. Mine No. 1		3·30	3·87	35·73	50·05	10·35	1·99	12620	4
Edwards. Edwards Mine No. 1		1·20	3·45	37·45	47·82	11·28	3·67	12469	4
Lehigh. Mine No. 7, Western C. & M. Co		2·70	5·74	31·46	37·05	25·75	4·06	9362	4
Lehigh. Mine No. 5, Western C. & M. Co		1·40	4·91	37·79	43·90	13·40	4·02	11389	4
Iowa Coal—									
Altoona. Gibson C. Co., Mine No. 4		9·80	4·52	40·96	38·99	15·53	6·83	11356	4
Avery. Smoky Hollow Coal Co. Mine No. 6		6·60	5·81	43·49	40·65	10·05	5·41		4
Avery. Smoky Hollow Coal Co. Mine No. 6		10·40	6·07	41·18	42·28	10·47	5·22	12114	4
Hamilton: Mammoth vein, C. Co. Mine 6		10·40	4·25	37·02	41·74	16·99	5·20	11182	4
Laddsdale, Anchor C. Co. Mine No. 2		3·20	5·21	31·76	46·51	16·52	5·20	11392	4
Kansas Coal—									
Atchison, Atchison mine		3·50	3·57	37·00	46·80	12·63	8·33	12337	4
Fleming. Mine No. 10		1·30	3·74	33·11	50·01	13·14	4·34	12404	4
Scammon. Mine No. 9 as received			2·50	33·80	51·25	12·45	5·68	12900	4

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
West mineral. Southwestern Development Co. No. 11		2·30	1·84	32·40	54·97	10·79	3·86	13199	4
West mineral. Southwestern Development Co. No. 11		2·30	4·10	31·65	53·71	10·54	3·77	12895	5
Yale. Western C. & M. Co. Mine No. 11		2·00	2·23	31·87	47·63	18·27	6·40	11880	4
Kentucky Coals—									
Central city. Central mine		3·00	8·47	35·24	46·81	9·48	3·60	11986	5
Earlington. Mine No. 11		2·70	5·36	38·99	46·27	9·38	3·72	12539	4
Earlington. Barnsley mine		2·20	5·85	36·90	46·96	10·29	3·60	12292	4
Jellico coal			4·40	31·56	61·87	1·86	0·314		1
Kensee. Main Jellico Mt. Coal Co		2·60	2·48	37·04	55·93	4·55	0·94	13972	4
Laurel county			4·64	31·50	61·00	2·86	1·12		3
Manchester (Altamount)			4·08	35·50	58·16	2·26	0·461		3
Pikesville coal			1·82	42·11	36·53	19·54	2·58		3
Pinesville coal			3·25	33·59	62·07	1·09	0·129		3
Providence coal			5·90	30·60	56·74	6·76	0·807		3
Straight Creek. Straight Creek mine No. 2		1·20	1·92	36·56	57·08	4·44	1·24	14319	4
Straight creek. Straight Creek mine No. 2		3·70	5·21	33·47	53·10	8·22	1·12	13214	5
Wheatcroft. Wheatcroft shaft mine		2·80	2·54	36·08	46·79	14·59	4·67	12294	4
Margland Coal—									
Big vein, Cumberland. Alleghany co			1·69	16·11	74·87	7·32	0·14		3
Georges creek. Alleghany co			1·84	11·07	81·95	5·06	0·07		2
" "			2·00	14·85	78·33	4·57	0·24		2
" "			1·83	12·85	78·08	6·83	0·50		2

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Westport, Washington No. 3 mine		1·40	2·33	16·11	68·43	13·13	1·49	13255	5
Michigan Coals—									
Bay co. Upper Verne coal, Winona mine			2·06	41·40	51·89	4·65			10
Bay co. Upper Verne coal, Old Monitor mine			10·03	35·36	49·94	4·67	1·12		10
Bay co. Upper Verne coal, Valley mine			1·70	35·50	53·30	9·50			10
Bay co. Upper Verne coal, Central Coal Co			4·32	40·57	42·16	12·75			10
Bay co. Lower Verne. Michigan C. & M. Co			5·01	39·62	41·67	13·70	6·66		10
Bay co. Lalzburg mine			6·50	43·61	47·82	2·07	0·89		20
Bay co. Wolverine No. 2 (Verne coal)			6·76	42·67	42·01	8·65	3·50	12295	20
Bay co. Wolverine No. 2 (Verne coal)			6·18	46·10	40·88	6·84	2·27	13335	20
Bay co. Wolverine No. 2 (Verne coal)			4·14	45·70	42·14	8·02	3·53	12520	20
Missouri Coals—									
Barnet. Morgan Co. Coal Co		7·70	5·39	44·91	44·47	5·23	5·55	13529	4
Bevier. Northwestern C. & M. Co. Mine No. 8		2·60	9·14	34·53	39·02	17·31	5·30	10451	4
Lexington. Summit mine		11·08		35·85	39·77	13·30	2·86	10957	4
Mendota. Mendota mine, slack coal		10·80	5·51	32·08	39·11	23·30	4·13	9911	4
Sprague. New Home, mine No. 1		5·00	3·50	35·35	40·77	20·38	5·53	11144	4

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Montana Coals—									
Red Lodge. Northwestern Improvement Co		2·20	9·05	36·70	43·03	11·22	1·76	10777	4
New Mexico Coals—									
Albuquerque. Brook's mine			6·55	25·75	44·28	23·42	0·45	.....	4
Algodones. Sloan's mine			9·68	42·32	41·36	6·64	0·66	.....	4
Algodones. Hagen mine. Hopewell bed			7·81	44·72	41·80	5·67	0·69	.....	4
Gallup. Otero mine, slack coal		2·90	8·13	34·82	37·83	19·22	1·30	10202	4
Gallup. Weaver mine. American Fuel Co		1·60	10·86	35·14	46·90	7·10	0·64	11435	4
North Dakota—									
Lehigh. Lehigh mine, Stark co		23·60	15·42	38·73	33·61	12·24	2·02	9061	4
Williston. Williston mine		24·10	16·70	37·10	39·49	6·71	0·63	9491	4
Wilton. McLean co		12·70	35·96	31·92	24·37	7·75	1·15	7069	5
Near Turtle mountain			13·98	40·81	36·90	8·31	.....	.....	7
Oregon—									
Beaver Hill			11·48	33·16	51·99	2·82	0·54	.....	2
Ohio—									
Bradley, Jefferson co. Crow Hollow mine		1·40	3·53	37·45	49·90	9·12	3·47	13072	5
Brilliant, Jefferson co., Pittsburgh coal bed		2·90	2·44	35·91	50·63	11·02	3·16	.....	4
Clarion. Vinton co. Clarion mine		3·20	5·59	36·86	49·26	8·29	3·15	12773	5
Dixie. Perry co. Dixie mine		4·50	7·55	38·00	46·08	8·37	2·84	12128	5
Danford Guernsey. Forsythe mine		2·60	6·65	33·94	48·86	10·55	3·13	12179	5
Neffs. Belmont co. Mine No. 1		3·90	5·31	36·72	49·45	8·52	3·33	12843	5

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Rush run, Jefferson co. Rush run mine No. 1		2·40	4·34	35·53	52·83	7·30	1·72	13178	5
Shawnee, Perry co. Goslin and Barbour mine		3·90	9·90	33·66	44·86	11·58	1·81	11277	5
Wellston, Jackson co., Superior Coal Co. Mine No. 10		3·60	9·01	35·85	43·80	11·34	4·02	11495	5
Wellston, Jackson co., Superior Coal Co. Mine No. 10		4·90	7·71	38·32	42·02	11·95	4·61	11515	5
Island creek, Jefferson co., Finley coal bed		1·90	2·03	37·17	53·26	7·54	3·70	.....	4
New Alexandra, Jefferson co., Pittsburgh coal bed		2·80	2·46	35·69	52·13	9·72	2·45	.....	4
Georges run, Jefferson co., Pittsburgh coal beds		3·80	2·86	35·84	52·35	8·95	2·62	.....	4
Pennsylvania Coals—									
Anderson. Pittsburgh bed			1·70	37·20	55·83	5·27	1·13	14335	4
Average of 30 anthracite car loads			3·30	3·80	84·00	8·40	0·50	.....	21
Argyle mine. Cambria county			4·33	10·68	80·49	4·07	0·42	.....	2
" "			2·71	11·41	79·97	5·06	0·83	.....	3
" "			1·50	15·28	78·19	4·75	0·28	.....	3
Ames bed. Bigger creek. Murdockville			2·15	39·15	52·65	6·05	3·64	.....	4
Beallsville. Waynesburg bed		1·40	1·18	33·62	48·01	17·19	3·27	.....	4
Berlin. Platt coal bed			1·00	18·17	53·52	21·92	5·38	.....	9
" "			0·87	20·33	68·94	8·68	1·76	.....	9
Berlin coal bed. Berlin, Somerset co.			1·94	21·93	68·55	6·40	1·16	.....	9
" "			2·01	20·53	68·32	8·39	0·74	.....	9

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Berlin coal bed. Berlin, Somerset co			1·62	22·76	67·46	7·34	0·80		9
Bertha mine, Bruce		1·30	2·61	34·92	56·30	6·17	1·26	13997	5
Bernice coal area. Bed B			1·29	8·10	83·34	6·23	1·03		22
Big Bend. Twin rocks			1·35	15·98	75·01	6·66	1·00		3
Cameron. Colliery, Northumberland co.: lump			1·81	6·18	86·74	4·50	0·75		9
Cameron. Colliery, Northumberland co.: slack			2·28	6·62	75·72	14·18	1·19		9
Cameron. Colliery, Northumberland co.: slack			3·17	6·84	76·63	11·99	1·35		9
Carmichaels. Waynesburg bed			1·03	38·30	48·96	8·96	2·72		9
Clinton. Pittsburgh bed			3·55	35·55	47·55	13·55	1·41		4
Durban. Waynesburg bed		1·20	1·61	36·49	48·93	12·97	3·51		4
Ehrenfield, Cambria co		2·90	3·51	16·82	73·04	6·63	0·94	14279	5
Ellsworth Coll. No. 2. Pittsburgh bed			1·05	36·65	57·25	5·05	0·91		4
Ellsworth Coll. No.1. Pittsburgh bed			1·22	36·28	56·24	6·26	0·84		4
Ellsworth Nos. 1 and 2. Pittsburgh bed		1·00	2·46	34·48	57·01	6·05	0·88	14013	5
Eureka. Clearfield co			2·03	20·05	71·63	4·32	1·96		2
Eureka No. 22. Clearfield co			1·64	19·41	74·43	4·39	0·13		1
" "			1·11	14·28	80·32	4·00	0·29		1
East Millsboro. Hustead-Seamens mine		2·40	3·46	31·80	51·74	13·00	1·95		5
" "		2·00	3·24	31·78	52·46	12·52	1·94	12879	5
Elk Lick. Jenner Cross roads			0·89	20·52	65·90	11·54	1·14		9
Frankfort. Pittsburgh bed			2·51	35·49	50·15	11·85	3·24		4
Freeport, upper coal bed, Hookston			1·50	39·87	46·96	7·07	4·59		9

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Freeport, upper coal bed, Hookston	.....	.....	1·37	37·80	54·46	4·78	1·58	.....	9
" " "	.....	.....	2·08	39·52	54·69	2·46	1·24	.....	9
Freeport, upper coal bed near Homer	.....	.....	0·59	28·71	52·48	12·75	5·46	.....	9
" " "	.....	.....	0·70	29·68	63·76	4·13	1·71	.....	9
" " "	.....	.....	0·80	25·77	70·22	2·58	0·62	.....	9
" " Salina stat.	.....	.....	1·06	33·95	54·39	9·53	1·05	.....	9
" " Somerset	.....	.....	0·86	16·88	66·05	15·61	0·58	.....	9
Gazzan. Clearfield co.	.....	.....	2·13	20·28	70·62	6·69	0·28	.....	1
Greensburg. Jamison mine	.....	2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Gallitzin coal bed. Wurtemburg	.....	.....	1·94	39·26	55·82	2·24	0·72	.....	9
Hackett. Redstone bed	.....	.....	1·46	35·56	53·39	9·59	2·05	.....	4
Hackett. Pittsburgh bed	.....	.....	1·72	36·98	56·55	4·75	1·15	.....	4
Homer. Freeport upper bed	.....	.....	0·59	28·71	52·48	12·75	5·46	.....	9
Hookston. Freeport upper bed	.....	.....	1·50	39·87	46·96	7·07	4·59	.....	9
Houtzdale. Mount Vernon coal	.....	.....	2·04	17·40	74·20	5·65	0·71	.....	3
Hustead-Seamens mine. E. Millsboro	.....	2·40	3·46	31·80	51·74	13·00	1·95	.....	5
Hustead-Seamens mine. E. Millsboro	.....	2·00	3·24	31·78	52·46	12·52	1·94	12879	5
Jamison mine	.....	2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Jenner Cross roads, Elk Lick coal	.....	.....	0·89	20·52	65·90	11·54	1·14	.....	9
Jefferson, Green co. Waynesburg bed	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kimmelton Kimmelton mine	.....	2·60	3·09	17·29	68·29	11·33	2·04	13424	5
Lackawanna	.....	.....	3·13	6·79	81·71	8·01	0·35	.....	2
Lehigh coal-market sizes. Egg	.....	.....	1·72	3·51	88·49	5·66	0·60	.....	21
" " Stove	.....	.....	1·42	4·15	83·67	10·17	0·57	.....	21

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Lehigh coal-market sizes. Nut			1·73	4·04	80·71	12·66	0·84	.....	21
" " Pea			1·70	3·89	79·04	14·64	0·69	.....	21
" " Buckwheat			1·69	4·05	76·91	16·62	0·71	.....	21
Ligonier. Ligonier mine		3·20	4·09	20·62	62·82	12·47	2·08	13153	5
London, S. H. Pittsburgh bed			2·48	38·74	49·18	9·60	1·85	13172	4
Loyal Hanna. Westmorland co.			2·03	22·96	65·84	7·88	1·29	.....	3
" "			2·59	12·11	59·66	4·80	0·83	.....	2
Lykens valley. Williamstown colliery			2·27	8·83	78·83	9·39	0·67	.....	9
Lykens valley. Williamstown colliery			1·93	7·25	82·01	8·27	0·52	.....	9
Lykens valley. R.A.			0·68	5·19	84·34	9·62	0·16	.....	2
Lloydell. Cambria co.			3·19	12·50	80·50	3·72	0·11	.....	3
" "			1·56	14·68	80·37	3·39	0·10	.....	3
Mahony. Schuylkill			0·45	2·15	94·63	2·63	0·13	.....	2
Mahony. Schuylkill. No. 2 colliery			3·57	0·90	86·85	8·49	0·18	.....	2
Mammoth vein. Schuylkill coal			2·98	3·38	87·13	5·85	0·65	.....	9
Manifold. Pittsburgh bed			1·37	37·10	53·84	7·69	1·61	.....	4
Mapleton. Sewickley coal			1·50	30·42	55·04	11·63	1·40	.....	9
Masontown. Sewickley coal			1·06	34·80	53·53	8·16	2·43	.....	9
Meadowland. Pittsburgh bed			1·90	36·20	53·70	8·20	1·52	.....	4
Midland. Pittsburgh bed		1·60	2·06	34·79	51·95	11·20	1·93	.....	4
Monongahela city. Redstone bed			1·06	33·59	48·68	14·29	2·36	.....	9
" gas coal			1·95	32·88	57·50	7·67	2·88	.....	3
Morea. Middle Lehigh			0·97	1·11	93·99	3·79	0·13	.....	2
" "			0·84	1·54	90·22	7·19	0·20	.....	2
Morrisdale. Clearfield			1·94	14·19	77·32	6·07	0·46	.....	3
Moshannon creek. Clearfield			1·74	21·95	67·96	7·25	1·09	.....	2

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Mount Vernon. Houtzdale			2·04	17·40	74·20	5·64	0·71		3
Murdocksville. Ames bed			2·15	39·15	52·65	6·05	3·64		4
Natalie. Shamokin district			0·48	11·13	79·23	9·02	0·12		2
New Pardee. Ratton			2·20	17·45	70·86	9·34	0·14		1
Nottingham mine. Pittsburgh bed			1·72	36·98	56·55	4·75	1·15		4
Old Victor. Clearfield co.			1·13	14·32	82·20	2·21	0·13		1
Otto mine. R. A.			0·80	4·86	84·57	9·53	0·23		2
Pardee, Cambria co.			1·94	18·25	72·99	6·31	0·51		3
Pardee, Patton. Cambria co.			5·68	28·84	61·66	3·48	0·32		1
" "			3·80	15·81	74·92	4·90	0·45		2
" "			1·94	18·25	72·99	6·31	0·51		2
" "			1·95	13·90	74·16	9·30	0·69		2
Paris. Pittsburgh bed			1·95	39·05	47·30	11·70	3·87		4
Philson coal bed, near Ursina			0·92	22·95	66·99	6·03	3·09		9
Pittsburgh bed. Blanche mine. Anderson			1·70	37·20	55·83	5·27	1·13	14335	4
Pittsburgh bed. Clinton			3·35	35·55	47·55	13·55	1·41		4
" Ellsworth, Coll. No. 1			1·22	36·28	56·24	6·26	0·84	14247	4
" Ellsworth, Coll. No. 2			1·05	36·65	57·25	5·05	0·91		4
" Ellsworth, Coll. Nos. 1 and 2		1·00	2·46	34·48	57·01	6·05	0·88	14013	5
Pittsburgh bed. Frankfort			2·51	35·49	50·15	11·85	3·24		4
" "			1·54	38·21	48·57	11·68	4·12		4
" Greensburg, Jamison mine		2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Pittsburgh bed. Nottingham mine, Hackett			1·72	36·98	56·55	4·75	1·15		4

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Pittsburgh bed. London, S. H.	.....	.....	2·48	38·74	49·18	9·60	1·85	13172	4
" Manifold mine	.....	.....	1·37	37·10	53·84	7·69	1·61	.....	4
" Meadowlands, Mc-Lains mine	.....	.....	1·90	36·20	53·70	8·20	1·52	.....	4
Pittsburgh bed. Midland mine, No. 3	.....	1·60	2·06	34·79	51·95	11·20	1·93	.....	4
Paris	.....	.....	1·95	39·05	47·30	11·70	3·87	.....	4
Pittsburgh mine, Warriors point	.....	.....	2·95	35·75	48·65	12·65	3·29	.....	4
" Sodom S.H.	.....	1·20	1·87	38·78	52·85	6·50	1·78	.....	4
" No. 1	.....	.....	4·14	30·12	63·01	2·75	0·17	.....	3
Platt coal bed. Berlin	.....	.....	1·00	18·17	53·52	21·92	5·38	.....	9
Powellton coal	.....	.....	1·46	12·56	79·82	6·16	0·14	.....	3
Powhattan coal	.....	.....	4·50	1·06	86·67	7·56	0·33	.....	3
Price coal bed. Berlin	.....	.....	0·87	20·33	68·94	8·68	1·76	.....	9
" Summerhill, Cambria co.	.....	.....	0·82	19·15	70·17	9·41	0·44	.....	9
	.....	.....	0·55	17·32	61·63	19·46	1·03	.....	9
Ratton. New Pardee coal	.....	.....	2·20	17·45	70·86	9·34	0·14	.....	1
Redstone bed, Hackett. Russell mine	.....	.....	1·46	35·56	53·39	9·59	2·05	.....	4
Redstone bed. Monongahela city	.....	.....	1·06	33·59	48·68	14·29	2·36	.....	9
Rockhill. Robertsdale	.....	.....	2·97	13·38	80·28	3·42	0·62	.....	3
Ryerson Sta. Washington bed	.....	0·50	1·73	36·97	47·20	14·10	3·81	.....	4
Salina Sta. Freeport upper bed	.....	.....	1·06	33·95	54·39	9·53	1·05	.....	9
Schuylkill. Kohonoor Colliery No. 1	.....	.....	3·34	1·86	87·96	6·70	0·13	.....	2
Schuylkill mammoth vein. Gilbertson Colliery	.....	.....	2·98	3·38	87·13	5·85	0·65	.....	9
Schuylkill. Mahony Colliery No. 1	.....	.....	0·45	2·15	94·63	2·63	0·13	.....	2
" " No. 2	.....	.....	3·57	0·90	86·85	8·49	0·18	.....	2

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Sewickley coal bed. Mapleton			1·50	30·42	55·04	11·63	1·40		9
" " Masontown			1·06	34·80	53·53	8·16	2·43		9
Shamokin district, Natalie coal			0·48	11·13	79·23	9·02	0·12		2
Shawmut mine No. 1. Elk co			2·95	29·45	62·40	5·20	1·76		3
Shawmut mine No. 2. Elk co			2·54	27·00	61·92	8·54	1·96		3
" " Elk co			2·68	32·06	61·67	3·59	0·28		3
Shenandoah. Schuylkill			0·80	1·06	85·25	11·81	1·08		2
Sodom, S.H. Pittsburgh bed		1·20	1·87	38·78	52·85	6·50	1·78		4
Somerset. Freeport upper bed			0·86	16·88	66·05	15·61	0·58		9
Sonoman			2·57	12·62	79·50	5·09	0·23		3
Summerhill. Price coal bed			0·82	19·15	70·17	9·41	0·44		9
			0·55	17·32	61·63	19·46	1·03		9
Twin Rocks. Big Bend			1·35	15·98	75·01	6·66	1·00		3
Ursina. Philson coal bed			0·92	22·95	66·99	6·03	3·09		9
Warriors point. Pittsburgh bed			2·95	35·75	48·65	12·65	3·29		4
Washington bed, Ryerson Sta		0·50	1·73	36·97	47·20	14·10	3·81		4
" Washington co			1·69	39·15	46·65	10·52	1·97		23
Waynesburg bed, near Beallsville		1·40	1·18	33·62	48·01	17·19	3·27		4
" "			1·23	36·18	46·72	12·88	2·97		22
Waynesburg bed. Jefferson Minors bank			1·23	33·13	49·11	14·81	1·70		9
			1·17	35·61	49·72	11·20	2·28		22
Waynesburg bed. Carmichaels			1·03	38·30	48·96	8·96	2·72		9
" Carmichaels			1·18	32·58	51·58	13·58	1·36		22
" Durbin. Crab-apple mine		1·20	1·61	36·49	48·93	12·97	3·51		4
Waynesburg bed, near Waynesburg			2·26	33·68	49·59	13·19	1·27		22
" Zolarville		1·70	1·22	32·23	46·55	20·00	4·51		4

UNITED STATES COALS.

Localities	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Waynesburg bed, Zolarville		1·30	0·98	32·82	47·75	18·45	2·93	.....	4
Wilkesbarre			3·47	3·67	83·97	8·64	0·25	.....	2
Williamstown colliery, Lykens Valley coal			2·27	8·83	78·83	9·39	0·67	.....	9
Williamstown colliery, Lykens Valley coal			1·93	7·25	82·01	8·27	0·52	.....	9
Williamstown colliery, Lykens Valley coal			0·68	5·19	84·34	9·62	0·16	.....	2
Windber, Somerset co., Eureka mine, No. 31			1·10	15·80	75·69	7·41	1·49	14499	4
Windber, Somerset co., Eureka mine, No. 31			0·59	16·61	76·76	6·40	0·91	14753	4
Wurtemburg, Gallitzin coal bed			1·94	39·26	55·82	2·24	0·72	.....	9
" "			1·93	40·12	55·60	1·49	0·83	.....	9
Wyoming mine, W.A.			0·47	7·13	85·18	4·78	0·44	.....	2
Youghiogheny. Ocean mine No. 2			2·41	29·69	64·94	2·94	0·02	....	3
" " No. 1			2·78	26·76	62·26	8·20	0·22	.....	3
Zolarville. Waynesburg bed		1·70	1·22	32·23	46·55	20·00	4·51	.....	4
		1·30	0·98	32·82	47·75	18·45	2·93	.....	4
Tennessee Coal—									
Cripple creek, near Briceville			3·20	30·04	63·42	3·34	0·43	.....	3
Fraterville			2·37	31·47	62·72	3·44	0·30	.....	
Coal creek, near Knoxville			2·33	2·53	82·14	13·00	0·23	.....	3
" near Knoxville			3·16	27·22	65·42	4·00	0·20	.....	1
" Black Diamond mines			3·34	31·95	62·68	2·03	0·25	.....	3
Oneida, Paint Rock coal			5·15	28·11	61·44	5·40	0·18	.....	3

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Mingo, Mingo coal			3·61	30·23	64·37	1·65	0·14	.....	1
" "			3·54	27·96	62·08	4·66	1·74	.....	1
Texas Coal—									
Hoyt Mines No. 1		5·80	24·48	38·17	28·94	8·41	0·53	8489	4
" Mines No. 2		25·80	10·66	39·42	40·11	9·81	0·71	9904	4
Thurber		.....	5·57	32·93	49·43	12·07	0·64	.....	3
Wooster Sta., south of Crockett		16·30	20·55	47·20	19·41	12·84	0·67	8534	4
		24·00	13·40	42·75	29·00	14·85	1·04	9358	4
		20·00	16·88	40·42	29·75	12·95	0·79	9083	4
Virginia Coal—									
Crab Orchard. H. C. Morris Prospect		2·40	4·06	34·93	56·28	4·73	1·20	13826	5
Crab Orchard. Big opening, Wilson farm		1·90	3·35	35·13	55·94	5·58	0·92	13932	5
Darby. Darby mine, Lee county		2·00	4·35	36·89	54·43	4·33	0·79	13939	5
Dorchester		.....	2·36	28·52	65·66	3·46	0·43	.....	3
Stonega		.....	2·20	30·65	64·78	2·37	0·12	.....	3
Looney creek		.....	2·83	31·51	63·70	1·96	0·22	.....	3
Toms creek. Cobourn mine		2·20	3·05	31·65	60·82	4·48	0·67	14470	5
" Banner coal		.....	1·25	28·78	64·69	4·15	0·12	.....	2
" Banner coal		.....	1·32	29·20	64·51	3·80	0·16	.....	2
West Virginia—									
Acme. Keystone mine		2·10	2·82	32·20	56·95	8·03	1·38	13766	5
Anstead. Gauley Mountain mine		2·60	1·60	32·12	58·92	7·36	0·92	14153	4
Big Sandy, Big Sandy mine		1·10	0·62	18·05	74·38	6·95	0·69	14...	4

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Bretz. Bretz Mine		0·50	0·98	28·72	61·87	8·43	0·90	14139	4
" No. 2 mine, Elkins Coal Co.		2·60	3·91	26·68	59·30	10·11	1·07	13370	5
" 2½ miles from Bretz		2·50	3·46	27·29	61·13	8·12	1·45	13869	5
Clarksburg. Ocean mine		0·90	2·01	37·51	52·13	8·55	2·54	13811	5
" Pitcairn mine		0·50	1·46	40·14	50·50	7·90	3·50	13860	4
Coalton. Coalton mine		0·80	0·65	29·20	59·97	10·18	0·99	13828	4
Colliers. Pittsburgh bed	4'–7"	2·80	2·33	33·97	51·93	11·77	2·82	.....	4
Elk Garden. West Virginia Mineral Co.		.....	1·11	11·68	80·67	6·45	0·09	.....	1
Glen Alum. Glen Alum mine		1·60	2·86	33·23	58·08	5·83	0·67	14106	5
Kingmount. Kingmount mine		0·40	1·35	36·92	55·36	6·37	0·90	14164	4
McDonald. McDonald mine		2·30	2·96	22·74	69·29	5·01	0·89	14425	5
Monongha. Monongha mine No. 6		4·40	5·57	31·61	54·45	8·37	1·20	13093	5
Mora. Mora mine		1·10	0·65	18·80	75·92	4·63	0·57	15190	4
New River. Fayette county		.....	1·85	18·93	71·06	7·97	0·18	.....	2
Page. Fayette county, Mine No. 2		2·60	3·74	31·04	61·31	3·91	0·89	14436	5
Page. Fayette county, Mine No. 1		3·10	5·09	29·07	62·57	3·27	1·03	14110	5
Phillippi		.....	2·54	26·12	64·76	6·58	0·89	.....	3
Pocahontas, McDowell county		.....	1·02	13·59	80·10	5·15	0·14	.....	1
Powellton. Vulcan mine		3·10	1·01	29·53	62·67	6·79	0·80	14371	4
Richard. Richard mine		1·30	1·00	30·25	58·38	10·37	1·07	13736	4
Rush Run. Rush Run mine		0·90	0·64	21·74	72·53	5·09	0·66	14942	4
Summerville. Summerville bed	4'–2"	5·00	2·00	30·15	59·57	8·28	0·75	.....	4
" "		3·40	2·11	29·14	62·27	6·48	0·69	.....	4
Sun. Sun mine No. 1		3·20	0·76	20·54	73·61	5·09	1·20	14857	4
Thomas		.....	1·81	21·21	71·28	5·54	0·15	.....	3
Winifrede. Gas mine		2·10	3·57	36·38	55·20	4·85	1·32	13948	5

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Zalia. Rogers coal bed	3′–0″	4·00	2·56	35·29	51·82	10·33	5·25	.....	4
" Finley bed	3′–7″	2·90	1·29	37·86	51·40	9·45	5·25	.....	4
Zenith. Zenith mines Nos. 1 and 2		3·30	0·80	16·90	70·80	11·50	0·53	13970	4
Washington Coals—									
Bellingham bay			8·39	45·50	33·26	12·66	.....	.....	7
Black Diamond near Seattle			8·36	31·24	56·09	4·17	0·14	.....	1
" Mine No. 2			4·10	40·90	50·73	4·27	0·76	.....	6
" Morgan slope			4·32	43·18	49·81	2·69	0·47	.....	6
" Mine No. 14			6·28	41·22	50·30	2·30	0·39	.....	6
Blue canyon. Whatcom county			3·62	29·65	62·75	3·68	0·31	.....	1
Carbonado. No. 4 vein			1·02	37·02	49·12	12·84	0·0	.....	6
No. 8 vein			1·16	35·87	57·88	5·09	1·32	.....	6
" North 1 vein			1·34	35·22	56·67	6·77	1·43	.....	6
Claquato. Lewis mine			1·21	8·39	72·30	18·10	0·98	.....	6
Cokedale			0·53	26·67	64·51	8·29	0·68	.....	6
Elk Horn. Lewis county			3·25	1·04	77·95	17·53	0·23	.....	1
Fairhaven. Skagit county			2·40	20·17	62·40	14·89	0·14	.....	1
" "			4·98	33·03	59·98	2·01	0·20	.....	3
Franklin, near Seattle			7·75	30·31	46·67	15·08	0·19	.....	3
" "			4·47	36·08	56·40	2·88	0·16	.....	1
" "			4·76	33·86	57·58	3·80	0·09	.....	3
Green River coal			2·96	32·31	60·69	4·04	0·93	.....	6
Isaquash, Kings co., Bryant coal			17·38	27·33	46·27	8·35	0·21	.....	3
New Castle, Vein No. 4 near Seattle			16·91	28·99	48·32	5·78	0·16	.....	3
Renton. Occidental mine, vein No. 10			3·00	37·10	47·29	12·61	0·70	.....	6
" " vein No. 6			2·02	37·40	52·55	8·03	0·68	.....	6

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Renton. Occidental mine, vein No. 5			1·51	39·50	48·98	10·01	0·59		6
" " vein No. 4			2·50	34·71	48·38	13·40	0·50		6
" " vein No. 3			4·60	27·80	59·69	7·91	0·48		6
" " vein No. 1			4·06	32·78	58·52	4·64	0·58		6
" Co-operative Coal Co., vein No. 1			10·31	37·89	41·15	10·65	0·47		6
Renton. Co-operative Coal Co., vein No. 2			10·02	38·18	47·92	3·88	0·53		6
Renton. Co-operative Coal Co., vein No. 2			3·44	37·38	53·60	5·58	0·75		6
Roslyn: New Dip No. 2 mine			2·08	38·21	49·09	10·63	0·45		6
" Ole Elum opening			6·34	37·86	48·30	7·50	0·49		6
" Ole Elum coal			2·91	44·79	45·81	6·49	0·71		6
" Shaft No. 4			1·90	38·20	49·40	10·50	0·41		6
" from car load			5·02	37·00	40·63	17·35	0·47		6
" coal sampled at Victoria			2·90	31·60	50·60	14·9	.....	12021	6
" coal steamship test			3·56	32·04	54·55	6·85	0·106		3
" "			6·36	30·63	50·11	12·75	0·145		3
" "			3·42	30·82	53·65	11·94	0·15		1
Seattle, from vicinity of			11·60	35·49	45·97	6·44	.....		7
" "			11·66	35·93	45·97	6·44	.....		7
" "			4·16	44·84	43·86	7·14	.....		7
Tacoma, vicinity of			2·43	33·10	57·37	7·11	1·40		6
Wilkeson, Pierce co			1·74	22·50	56·89	18·71	0·14		1
" Mine No. 7			0·42	25·12	62·42	12·04	1·11		6
" Mine No. 3			0·53	32·10	65·20	2·17	1·86		6
" Mine No. 2			1·02	26·72	63·82	6·44	1·90		6

UNITED STATES COALS.

Localities.	Thickness of seam	Loss on air drying	Moisture	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value in B.T.U.	Reference No.
Wilkeson, Mine No. 1			0·63	28·11	61·53	9·73	2·09		6
Wyoming Coal—									
Aladdin. Stillwell mine		2·90	15·12	34·36	33·86	16·70	6·66	8928	5
Cambria. Antelope Mines 1 and 2		4·50	8·93	36·52	33·76	20·79	4·03	10001	5
" " "		6·90	2·73	37·61	37·41	22·26	4·17	10364	4
Sheridan. Monarch mine		6·00	17·69	37·96	39·56	4·79	0·63	10355	4
Kimmerer mine No. 1			5·43	37·17	53·61	3·19	0·41		3
Kimmerer mine No. 4			5·92	34·73	54·21	5·14	0.41		3

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This Summary Report forms No. 817, Part A, Vol. XV, 1902–3.

851. Mineral Resources Bulletin on Coal. Theo. Denis.

865. Summary Report for 1903 contains—
Coal basins in the Rocky Mountains in Sheep Creek and Cascade basins. D. B. Dowling, pp. 83–91.
This Summary Report forms No. 866, Part AA, Vol. XV, 1902–3.

868. Report on the Coal Fields of Souris River, Saskatchewan. D. B. Dowling. Part F, Vol. XV, Annual Report, 1902–3.

870. Contributions to Canadian Palaeontology, Vol. III. Part III. On *Dryptosaurus incrassatus* (Cope) from the Edmonton series. L. M. Lambe. 1904.

899. Summary Report for 1904 contains—
Natural History of the National Park. Prof. John Macoun, pp. 100–105.
Cascade Coal-basin. D. B. Dowling, pp. 105–115.
Costigan Coal-basin. D. B. Dowling, pp. 116–121.
This Summary Report forms No. 900, Part A, Vol. XVI, 1904.

947. Summary Report for 1905 contains—
The Northern Extension of the Elk River Coal Basin. D. B. Dowling, pp. 59–62.
The Foothills of the Rocky Mountains, south of the main line, Canadian Pacific Railway. D. D. Cairnes, pp. 62–67.

949. Report on Cascade Coal Basin. D. B. Dowling.

959. Summary Report for 1906 contains—
Rocky Mountain Coal Areas between the Bow and Yellowhead Passes. D. B. Dowling, pp. 66–73.

968. Report on Moose Mountain. D. D. Cairnes.

1017. Summary Report for 1907 contains—
Explorations in the Rocky Mountains, The Bighorn Coal Area. D. B. Dowling, pp. 32–34.
The Cascade, Palliser, and Costigan Coal basins. G. S. Malloch, pp. 35–41.

1072. Summary Report for 1908 contains—
The Bighorn Coal basin. G. S. Malloch, pp. 70–76.
Steam Coals of the Cascade Basin, Lignite Areas of Alberta and Sask., Production of Coal in Alberta and Sask. D. B. Dowling, pp. 77–86.

1120. Summary Report for 1909 contains—
Coal Fields south of the Grand Trunk Pacific Railway. D. B. Dowling, pp. 139–150.

1170. Summary Report for 1910 contains—
Coal Fields of Jasper Park, Alta. D. B. Dowling, pp. 150–168.

1218. Summary Report for 1911 contains—
Geology of Roche Miette Map Area, Jasper Park. D. B. Dowling, pp. 201–219.
Notes on Coal Occurrences and the Progress of Development Work in Alberta and Saskatchewan. D. B. Dowling, pp. 219–224.

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LIST OF RECENT REPORTS OF GEOLOGICAL SURVEY.

Since 1910, reports issued by the Geological Survey have been called memoirs and have been numbered Memoir 1, Memoir 2, etc. Owing to delays incidental to the publishing of reports and their accompanying maps, not all of the reports have been called memoirs, and the memoirs have not been issued in the order of their assigned numbers, and, therefore, the following list has been prepared to prevent any misconceptions arising on this account. The titles of all other important publications of the Geological Survey are incorporated in this list.

Memoirs and Reports Published During 1910.

REPORTS.

Report on a geological reconnaissance of the region traversed by the National Transcontinental railway between Lake Nipigon and Clay lake, Ont.—by W. H. Collins. No. 1059.

Report on the geological position and characteristics of the oil-shale deposits of Canada—by R. W. Ells. No. 1107.

A reconnaissance across the Mackenzie mountains on the Pelly, Ross, and Gravel rivers, Yukon and North West Territories—by Joseph Keele. No. 1097.

Summary Report for the calendar year 1909. No. 1120.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 1. *No. 1, Geological Series.* Geology of the Nipigon basin, Ontario—by Alfred W. G. Wilson.

MEMOIR 2. *No. 2, Geological Series.* Geology and ore deposits of Hedley Mining district, British Columbia—by Charles Camsell.

MEMOIR 3. *No. 3, Geological Series.* Palæoniscid fishes from the Albert shales of New Brunswick—by Lawrence M. Lambe.

MEMOIR 5. *No. 4, Geological Series.* Preliminary memoir on the Lewes and Nordenskiold Rivers coal district, Yukon Territory—by D. D. Cairnes.

MEMOIR 6. *No. 5, Geological Series.* Geology of the Haliburton and Bancroft areas, Province of Ontario—by Frank D. Adams and Alfred E. Barlow.

MEMOIR 7. *No. 6, Geological Series.* Geology of St. Bruno mountain, Province of Quebec—by John A. Dresser.

MEMOIRS—TOPOGRAPHICAL SERIES.

MEMOIR 11. *No. 1, Topographical Series.* Triangulation and spirit levelling of Vancouver island, B.C., 1909—by R. H. Chapman.

Memoirs and Reports Published During 1911.

REPORTS.

Report on a traverse through the southern part of the North West Territories, from Lac Seul to Cat lake, in 1902—by Alfred W. G. Wilson. No. 1006.

Report on a part of the North West Territories drained by the Winisk and Upper Attawapiskat rivers—by W. McInnes. No. 1080.

Report on the geology of an area adjoining the east side of Lake Timiskaming—by Morley E. Wilson. No. 1064.

Summary Report for the calendar year 1910. No 1170.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 4. *No. 7, Geological Series.* Geological reconnaissance along the line of the National Transcontinental railway in western Quebec—by W. J. Wilson.

MEMOIR 8. *No. 8, Geological Series.* The Edmonton coal field, Alberta—by D. B. Dowling.

MEMOIR 9. *No. 9, Geological Series.* Bighorn coal basin, Alberta—by G. S. Malloch.

MEMOIR 10. *No. 10, Geological Series.* An instrumental survey of the shore-lines of the extinct lakes Algonquin and Nipissing in south-western Ontario—by J. W. Goldthwait.

MEMOIR 12. *No. 11, Geological Series.* Insects from the Tertiary lake deposits of the southern interior of British Columbia, collected by Mr. Lawrence M. Lambe, in 1906—by Anton Handlirsch.

MEMOIR 15. *No. 12, Geological Series.* On a Trenton Echinoderm fauna at Kirkfield, Ontario—by Frank Springer.

MEMOIR 16. *No. 13, Geological Series.* The clay and shale deposits of Nova Scotia and portions of New Brunswick—by Heinrich Ries, assisted by Joseph Keele.

MEMOIRS—BIOLOGICAL SERIES.

MEMOIR 14. *No. 1, Biological Series.* New species of shells collected by Mr. John Macoun at Barkley sound, Vancouver island, British Columbia—by William H. Dall and Paul Bartsch.

Memoirs and Reports Published During 1912.

REPORTS.

Summary Report for the calendar year 1911. No. 1218.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 13. *No. 14, Geological Series.* Southern Vancouver island—by Charles H. Clapp.

MEMOIR 21. *No. 15, Geological Series.* The geology and ore deposits of Phoenix, Boundary district, British Columbia—by O. E. LeRoy.

MEMOIR 24. *No. 16, Geological Series.* Preliminary report on the clay and shale deposits of the western provinces—by Heinrich Ries and Joseph Keele.

MEMOIR 27. *No. 17, Geological Series.* Report of the Commission appointed to investigate Turtle mountain, Frank, Alberta, 1911.

MEMOIR 28. *No. 18, Geological Series.* The geology of Steeprock lake, Ontario —by Andrew C. Lawson. Notes on fossils from limestone of Steeprock lake, Ontario—by Charles D. Walcott.

Memoirs and Reports Published During 1913.

REPORTS, ETC.

Museum Bulletin No. 1; contains articles Nos. 1 to 12 of the Geological Series of Museum Bulletins, articles Nos. 1 to 3 of the Biological Series of Museum Bulletins, and article No. 1 of the Anthropological Series of Museum Bulletins.

Guide Book No. 1. Excursions in eastern Quebec and the Maritime Provinces, Parts 1 and 2.

Guide Book No. 2. Excursions in the Eastern Townships of Quebec and the eastern part of Ontario.

Guide Book No. 3. Excursions in the neighbourhood of Montreal and Ottawa.

Guide Book No. 4. Excursions in southwestern Ontario.

Guide Book No. 5. Excursions in the western peninsula of Ontario and Manitoulin island.

Guide Book No. 8. Toronto to Victoria and return via Canadian Pacific and Canadian Northern railways, Parts 1, 2, and 3.

Guide Book No. 9. Toronto to Victoria and return via Canadian Pacific, Grand Trunk Pacific, and National Transcontinental railways.

Guide Book No. 10. Excursions in northern British Columbia and Yukon Territory and along the North Pacific coast.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 17. *No. 28, Geological Series.* Geology and economic resources of the Larder Lake district, Ont., and adjoining portions of Pontiac county, Que.—by Morley E. Wilson.

MEMOIR 18. *No. 19, Geological Series.* Bathurst district, New Brunswick—by G. A. Young.

MEMOIR 26. *No. 34, Geological Series.* Geology and mineral deposits of the Tulameen district, B.C.—by C. Camsell.

MEMOIR 29. *No. 32, Geological Series.* Oil and gas prospects of the northwest provinces of Canada—by W. Malcolm.

MEMOIR 31. *No. 20, Geological Series.* Wheaton district, Yukon Territory—by D. D. Cairnes.

MEMOIR 33. *No. 30, Geological Series.* The geology of Gowganda Mining division—by W. H. Collins.

MEMOIR 35. *No. 29, Geological Series.* Reconnaissance along the National Transcontinental railway in southern Quebec—by John A. Dresser.

MEMOIR 37. *No. 22, Geological Series.* Portions of Atlin district, B.C.—by D. D. Cairnes.

MEMOIR 38. *No. 31, Geological Series.* Geology of the North American Cordillera at the forty-ninth parallel, Parts I and II—by Reginald Aldworth Daly.

Memoirs and Reports Published During 1914.

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Museum Bulletin No. 2: contains articles Nos. 13 to 18 of the Geological Series of Museum Bulletins, and article No. 2 of the Anthropological Series of Museum Bulletins.

Prospector's Handbook No. 1: Notes on radium-bearing minerals—by Wyatt Malcolm.

MUSEUM GUIDE BOOKS.

The archæological collection from the southern interior of British Columbia —by Harlan I. Smith. No. 1290.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 23. *No. 23, Geological Series.* Geology of the coast and islands between the Strait of Georgia and Queen Charlotte sound, B.C.—by J. Austen Bancroft.

MEMOIR 25. *No. 21, Geological Series.* Report on the clay and shale deposits of the western provinces (Part II)—by Heinrich Ries and Joseph Keele.

MEMOIR 30. *No. 40, Geological Series.* The basins of Nelson and Churchill rivers—by William McInnes.

MEMOIR 20. *No. 41, Geological Series.* Gold fields of Nova Scotia—by W. Malcolm.

MEMOIR 36. *No. 33, Geological Series.* Geology of the Victoria and Saanich map-areas, Vancouver island, B.C.—by C. H. Clapp.

MEMOIR 52. *No. 42, Geological Series.* Geological notes to accompany map of Sheep River gas and oil field, Alberta—by D. B. Dowling.

MEMOIR 43. *No. 36, Geological Series.* St. Hilaire (Beloeil) and Rougemont mountains, Quebec—by J. J. O'Neil.

MEMOIR 44. *No. 37, Geological Series.* Clay and shale deposits of New Brunswick—by J. Keele.

MEMOIR 22. *No. 27, Geological Series.* Preliminary report on the serpentine and associated rocks of southern Quebec—by John A. Dresser.

MEMOIR 32. *No. 25, Geological Series.*—Portions of Portland Canal and Skeena mining divisions, Skeena district, B.C.—by R. G. McConnell.

MEMOIRS—ANTHROPOLOGICAL SERIES.

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MEMOIR 45. *No. 3, Anthropological Series.* The inviting-in feast of the Alaskan Eskimo—by E. W. Hawkes.

Memoirs in Press, July 17, 1914.

MEMOIR 40. *No. 24, Geological Series.* The Archæan geology of Rainy lake—by Andrew C. Lawson.

MEMOIR 19. *No. 26, Geological Series.* Geology of Mother Lode and Sunset Mines, Boundary district, B.C.—by O. E. LeRoy.

MEMOIR 39. *No. 35, Geological Series.* Kewagama Lake map-area, Quebec—by M. E. Wilson.

MEMOIR 41. *No. 38, Geological Series.* The "Fern Ledges" Carboniferous flora of St. John, New Brunswick—by Marie C. Stopes.

MEMOIR 47. *No. 39, Geological Series.* Clay and shale deposits of the western provinces, Part III—by Heinrich Ries.

MEMOIR 51. *No. 43, Geological Series.* Geology of the Nanaimo map-area—by C. H. Clapp.

MEMOIR 53. *No. 44, Geological Series.* Coal fields of Manitoba, Saskatchewan, Alberta, and eastern British Columbia (revised edition)—by D. B. Dowling.

MEMOIR 61. *No. 60, Geological Series.* Moose Mountain district, southern Alberta (second edition)—by D. D. Cairnes.

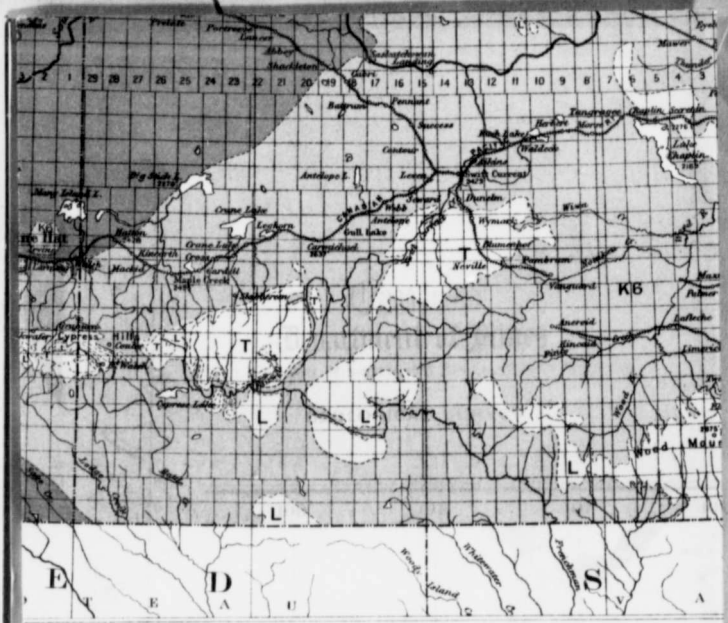
MEMOIR 42. *No. 1, Anthropological Series.* The double-curve motive in northeastern Algonkian art—by Frank G. Speck.

MEMOIR 49. *No. 4, Anthropological Series.* Malecite tales—by W. H. Mechling.

MEMOIR ... *No. 5, Anthropological Series.* Abnormal types of speech in Nootka—by E. Sapir.

MEMOIR ... *No. 6, Anthropological Series.* Noun reduplication in Comox, a Salish dialect of Vancouver island—by E. Sapir.

MEMOIR 46. *No. 7, Anthropological Series.* Classification of Iroquoian radicals and subjective pronominal prefixes—by C. M. Barbeau.



MAP 55A

(Reissued 1914, with minor geological additions)

Geological Map

of

RTA, SASKATCHEWAN AND M

Scale, 2,217,600

Miles

25 20 15 10 5 0 25 50 75 100 125

Kilometres

50 40 30 20 10 0 50 100 150 200

35 MILES TO 1 INCH

Canada
Department of Mines
HON. L. CODERRE, MINISTER; R. W. BROCK, DEPUTY MINISTER.

GEOLOGICAL SURVEY

MAP 55A
(Reissued 1914, with minor geological additions)

Geological Map of ALBERTA, SASKATCHEWAN AND MANITOBA

Scale, $\frac{1}{2,217,600}$

35 MILES TO 1 INCH